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ANNALS OF SURGERY

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PERFORATED GASTRODUODENAL ULCERS

A STUDY OF 166 CASES

HILDING B. OLSON, M.D.* AND MARTIN NORGORE, M.D.†

SEATTLE, WASH.

PERFORATION of intra-abdominal viscera is a serious condition. Peptic ulcer constitutes the most common cause of spontaneous perforation. Because of the high mortality associated with this condition, the present study was undertaken to determine what can be done to increase the rate of survival.

The data upon which this study is based was taken from the records of the King County Hospital, Seattle, Washington, and comprises the total number (166 cases) of perforated gastric and duodenal ulcers which came to this institution during a seven-year period from 1938 to 1944, inclusive. Many of the patients admitted to this hospital are in a poor state of nutrition; others are chronic alcoholics, old, and neglected. Most of the emergency surgery is done by the Resident Staff and junior members of the Attending Staff. Because of these factors the statistics cannot be compared with those in private practice, where the patients, as a rule, are in better physical condition. This study comprises only the intraperitoneal perforations of benign gastric, pyloric and duodenal ulcers. It does not contain perforation into other viscera such as the pancreas, gallbladder and bile ducts, nor does it include perforated malignant ulcers.

The etiologic factors are shown in Chart 1. They do not differ markedly from those already described by other authors.[8] Attention is called to the fact that 37, or 22.3 per cent, were acutely intoxicated upon arrival in the hospital. This makes the diagnosis and management of these patients difficult. They are uncoöperative and usually suffer from avitaminosis and hypoproteinemia. Two developed delirium tremens.

External trauma as an etiologic factor is interesting from the standpoint of workmen's compensation. One of us (M. N.) has had two instances of perforated duodenal ulcer which occurred while at work. The Department

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of Labor and Industries of the State of Washington accepted the responsibility for the surgical care and compensation of these patients. Corlette[8] studied the problem on the basis of the laws of physics and demonstrated that increase in intra-abdominal pressure cannot cause a strain in an ulcer; therefore, perforation from this cause cannot occur. There must be an increase in the hydrostatic pressure *within* the organ without increasing the intra-abdominal pressure, so as to have a difference in the two, before perforation can take place.

DeBakey,[8, 9] in a collected review, found that 5 to 33 per cent occurred while asleep. There are also reports of perforation following the administration of a barium meal.[8] Food indiscretion and overloading of the stomach undoubtedly play an important part. In about 50 per cent of our cases perforation occurred within three hours after eating a heavy meal. In our series no perforation resulted from administration of barium.

Bleeding was noted in 13 per cent. According to Einhorn,[10] and others,[8, 32] the blood supply of the duodenum accounts for this fact. Mayo[10] described the so-called anemic spot, which appears at times on the ventral wall of the first part of the duodenum when the intestine is stretched by traction on the pylorus. This is the most common site of duodenal ulcer, and is probably responsible for the axiom that a perforated ulcer seldom bleeds and a bleeding ulcer seldom perforates. Two patients had postsurgical hemorrhage. In most instances the blood loss was small and no patient in this group died.

Pain in the right lower quadrant was present in 20 per cent. Consequently, confusion in diagnosis arises, as one may suspect appendicitis or other lesions instead of the true pathologic condition. This is because the gastroduodenal contents spread downward in the right gutter. Rarely are acute appendicitis and perforated peptic ulcer present at the same time. Sanders[33] has reported such a case.

Shoulder radiation was, unfortunately, not recorded in 75 per cent of our cases. Of the 42 patients who were questioned in this regard, only seven had no pain. Raw[31] reported 60 per cent with radiation to the shoulder. This is an important diagnostic finding,[27] and the question should be asked of every patient. But as Cope[7] has pointed out, there are other conditions which give shoulder radiation at times, such as: subphrenic abscess, biliary tract disease, acute pancreatitis, appendicitis, ruptured ectopic pregnancy, diaphragmatic hernia, pulmonary conditions, and pericarditis. One must, therefore, evaluate this symptom in the light of the whole picture.

PHYSICAL FINDINGS

Obliteration of liver dullness is of value. The patient is placed on the left side for four or five minutes. If there is an appreciable amount of air in the abdominal cavity, liver dullness will not be found.[28] Whereas this was recorded in only 17 instances, the test was positive in 11. Again, the evaluation of this finding must be made in the light of other features, as there are several conditions which will produce pneumoperitoneum.

Shock is not a common finding, as measured by blood pressure and pulse rate. Only 7.2 per cent exhibited evidence of this condition. Detection of early shock, however, can be made better by hematocrit determination,[24] but this laboratory procedure was not done. When shock is present the prognosis is serious, and every effort should be made to combat it before, during, and after surgery. We are of the opinion that Blalock's[5] studies offer the best explanation for the occurrence of shock. By injecting bile, pancreatic, stomach, and duodenal secretions intraperitoneally he found that any of these

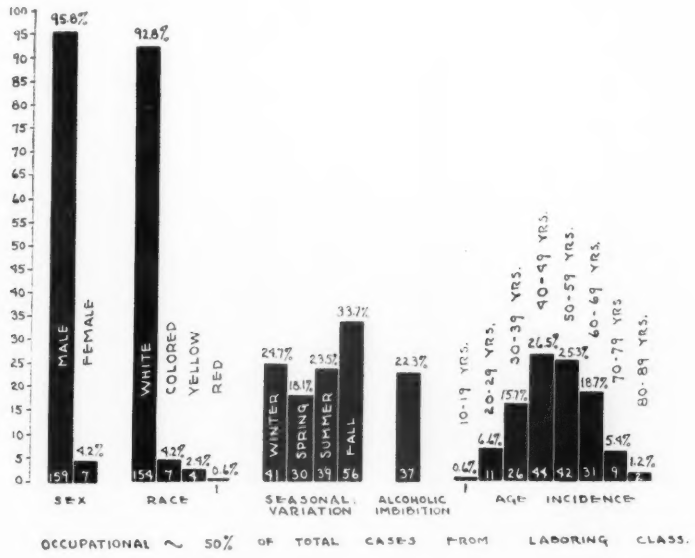

CHART 1.—Etiologic factors.

juices made the animals ill, with vomiting and increased pulse rate. When only one substance was injected, bile was found to be the most toxic. Infected pancreatic juice was next. But when bile and pancreatic juice were administered together there was decisive evidence of shock as measured by drop in blood pressure and cardiac output. Horrall,[18] and others,[22] have demonstrated the toxicity of bile when injected intraperitoneally. It is, therefore, believed that shock in perforated peptic ulcers is due largely to the action of bile and pancreatic juice, which is poured into the abdominal cavity. Hypo-albuminemia,[20] anemia, and dehydration also play important rôles.

Laboratory Findings: An important procedure is demonstration of pneumoperitoneum roentgenographically.[2, 8, 11] The patient is placed on the left side for at least 20 minutes, after which roentgenograms are taken of him in this position. One can better demonstrate free air intraperitoneally in this

manner than in the upright position, and a smaller amount is detectable by this maneuver. We have not tried DeBakey's[8] suggestion of injecting 20 to 30 cc. of air through a Levine tube placed in the stomach where no air could be found otherwise. Pneumoperitoneum must be interpreted in the light of the history and physical findings, as there are other conditions which will produce it.[28] Some of these are: recent celiotomy; peritoneoscopy; the Rubin test; ruptured appendicitis, especially when the perforation is near the cecum; perforated diverticulum or cancer of the intestinal tract.

The average leukocyte count was 12.422. In some instances there was no leukocytosis.

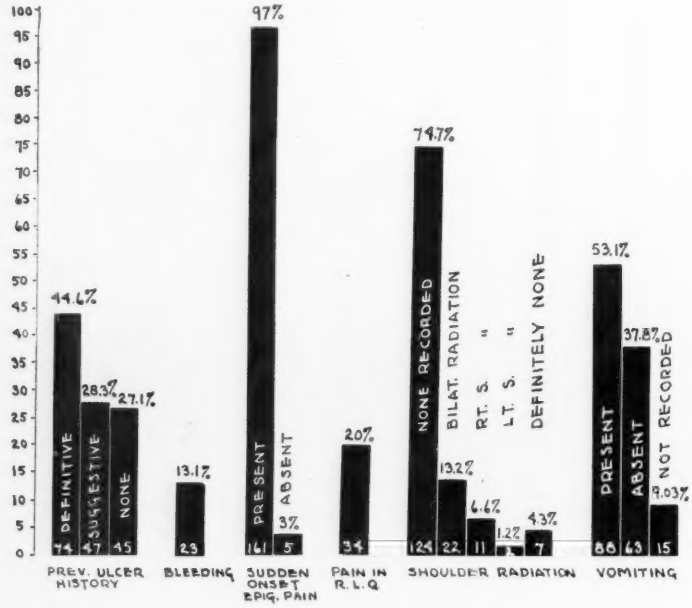

CHART 2.—Clinical history.

Ascorbic acid and serum protein levels were not determined in many instances, but a sufficient number was done to indicate the importance of these two factors in the treatment. Many patients suffering from peptic ulcer restrict the diet so that their biochemical balance is upset. If the hemoglobin is high,[24] it is an indication that shock is impending. Therefore, hematocrit determinations should be done, preferably in all cases and, certainly, in those where shock is suspected.

DIAGNOSIS

In 11, or 6.6 per cent, the condition was not recognized until autopsy. Most of these patients were moribund upon arrival in the hospital. In 14, or 8.4 per cent, other conditions were suspected, although in most of these,

perforated peptic ulcer was included in the differential diagnosis. Appendicitis was the most common error. Acute pancreatitis was thought of in 11 instances but was ruled out by the serum amylase test.

TREATMENT

Medical: Following the articles by Singer and Vaughan, in 1930[34] and 1932,[55] on *forme fruste* ulcers, one of our surgeons conceived the idea of treating selected patients with perforated peptic ulcer by suction and parenteral fluids. During the period included in this study, 17 patients were

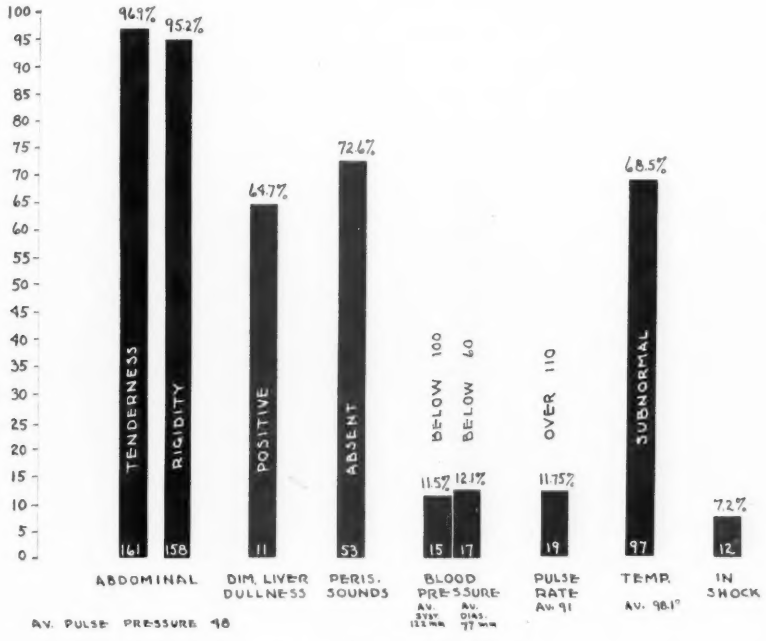

CHART 3.—Physical findings.

treated in this manner, of whom seven died, or a mortality rate of 41 per cent. While this series is too small from which to draw definite conclusions, it indicates that medical treatment is not the best procedure, even in selected cases. Consequently, this form of management has now been abandoned and is used only where operation is refused. One instance has been described[19] where a patient was treated 20 days by this method, but there still was no evidence of spontaneous closure of the ulcer. The patient was operated upon, but died 40 days later. However, this form of treatment[2] has demonstrated to us that suction is efficacious while the patient is being prepared for surgery by restoring biochemical and fluid balance. The period of hospitalization in this group averaged 20 days.

Surgical: Surgical treatment was instituted in 138 patients. It was found that an average of six and one-half hours elapsed from the time of perforation until admission to the hospital. Preparation for surgery took an additional two hours. In some instances the ulcer had perforated 24, 36, and even 72 hours before coming to the hospital. Attention is called to the promptness with which these patients were brought to surgery. As will be brought out later, we are of the opinion that in selected cases more time should be taken in the preparation of the patient before operation is performed.

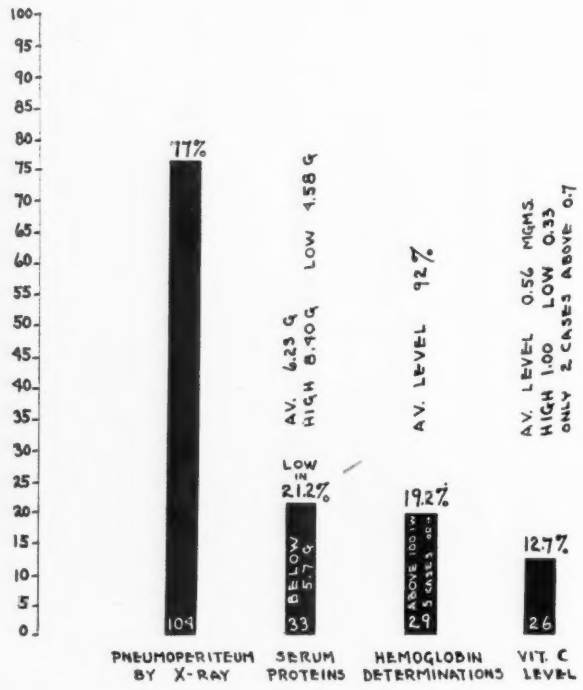

CHART 4.—Laboratory findings.

The type of incision is given in Table I. We feel that a transverse incision, about three inches in length, should be made; that the ulcer be closed, preferably with a living tag of omentum; that no sulfonamide drug be introduced into the abdomen or incision,[17, 26] nor drains inserted; and that as much of the stomach contents as possible be removed from the abdominal cavity. We have not practiced irrigation by the introduction of large amounts of saline. Although the number of procedures besides closing the ulcer were few, the data would indicate that such operations had better not be undertaken.[12-15] We make this statement despite good results reported by

surgeons who have performed partial gastrectomy,[4, 36] and gastro-enterostomy.[6, 23] in the presence of perforated peptic ulcers. A high percentage of these patients require no further operations after closure of the perforations.[9, 38] Table II summarizes the results in this regard. The average hospital stay was 16 days in this group.

Closure of the abdominal incision is important, as there were 24 wound infections and 14 wound dehiscences. It is our opinion that heavy catgut is contraindicated because of the exudate that accompanies the use of this material. Cotton, or preferably wire sutures (M. N.), have been found to be the most efficacious of all the suture materials used at present. Fine wire, No. 34 or 36, interrupted sutures produce no tissue reaction and seem to cause no after irritation. However, one must not rely on sutures alone to hold the incision together. Adequate serum protein and ascorbic acid levels must be maintained. It is our impression that sulfonamides introduced into the wound would hinder the healing process. We usually irrigate the incision after the peritoneum has been closed.

TABLE I

TYPE OF INCISION

	No. of Cases	Wound Infection	Wound Disruption	Hematoma	Sulpha in Wound	
					Infection	None
1. Right upper rectus	106	16	13	0	7	10
2. Right subcostal	10	2	0	2	1	0
3. Midline (upper)	6	2	2	0	1	0
4. Transverse (above umbilicus	3	0	0	0	1	0
5. All others	6	2	0	0	0	0

TABLE II

REPAIR OF PERFORATION

	No. of Cases	Deaths	Percentage Mortality
Types of ulcer repair:			
a. Simple plication, with or without omentum	99	16	16.2
b. Simple plication plus drainage	19	6	31.5
c. All others	15	4	26.6

Anesthesia: Ether was administered in 93 instances and spinal in 19. Pentothal, nitrous oxide, and local infiltration were used in the remainder. Spinal anesthesia is desirable[13] if the patient's condition permits its use, as it gives good relaxation. It should not be used if the hemoglobin is less than ten grams per hundred cc. of blood. In poor risks, intercostal block and local infiltration of procaine or metycaine are valuable procedures. The average length of operation was 52 minutes.

Complications: The most important data regarding complications is given in Chart 5. If there is a rapid rise in temperature and pulse during the first three days following operation, pulmonary complications are to be looked for. If the patient is not doing well after the third day, intra-abdominal infections must be thought of, the most common being: peritonitis; pelvic

or subphrenic abscess, right or left. In our series, seven patients developed pelvic and, five, subdiaphragmatic abscesses. Reperforation occurred in two instances, therefore, this possibility must be kept in mind. Wound infection and dehiscence are serious complications, which have already been discussed.

Mortality: As will be seen from Chart 6, most of the deaths were due to peritonitis and pulmonary complications. However, some died from unrelated causes. Among them were two coronary occlusions and one ulcerative aortic endocarditis. The latter patient succumbed on the 37th postoperative day. It is believed that the primary disease had nothing to do with his demise. The over-all mortality was 27.7 per cent.

TABLE III

Year	No. of Cases	Treatment		Deaths		Percentage Mortality		Undiagnosed Proven at Autopsy
		Surg.	Med.	Surg.	Med.	Surg.	Med.	
1938	28	22	1	3	0	13.5	00.0	5
1939	25	23	2	10	0	43.5	00.0	0
1940	18	16	2	3	2	18.9	100.0	0
1941	19	12	4	5	0	41.7	00.0	3
1942	23	17	3	1	3	05.9	100.0	3
1943	29	25	4	2	2	08.0	50.0	0
1944	24	23	1	4	0	17.0	00.0	0
7 yrs.	166	138	17	28	7	21.0	41.2	11 or 6.6 per cent.

DISCUSSION.—The over-all mortality in our group is high, but not greater than recorded[16] in collected reports,[8, 9] or in large series from similar institutions,[37] such as the Cook County Hospital.[21] Reports on 30 to 90 cases[9, 12, 15, 25] have been made with lower mortality, but these have usually been private patients treated by one surgeon. It is interesting to note that Graham, in recording 51 duodenal perforations,[12] had a mortality of 1.9 per cent. When this series was extended to 106[13] cases, the death rate had risen to 6 per cent.

Most authors emphasize the importance of early operation. We agree with this view. But how are we to manage those patients who do not come to the hospital until the optimum time for operation has passed, or who are in a poor physical state? In reviewing this series, it was found that some patients died within a few hours after operation had been performed. One died on the way to the operating room. Two expired under anesthesia, before surgery could be instituted. As Graham[12] has pointed out, the old adage that the sun should neither set nor rise on a perforated ulcer is no longer valid. If a patient is in such a condition that he succumbs on the way to the operating theater, or dies a short time after surgery has been performed, it would seem prudent not to operate upon him until his condition has been improved. This can usually be accomplished by suction, the introduction of fluids, plasma, blood transfusions and vitamins — in short, restoring the biochemical and fluid balance. The patient should have a reasonable chance to survive the

operation before surgery is instituted. At present, this can be measured to a fair degree of accuracy by hematocrit, plasma protein determinations, ascorbic acid levels, as well as the general appearance of the patient. Peritonitis, although an important lethal factor, need not be feared as much now that we have the sulfonamide drugs and penicillin. These agents should be administered while the patient is being prepared for surgery. Again, medical management of these patients has indicated that by intragastric suction very little gastroduodenal content is spilled into the peritoneal cavity. Actual spontaneous sealing-off of the ulcer might occur.[37] Since it has been demonstrated

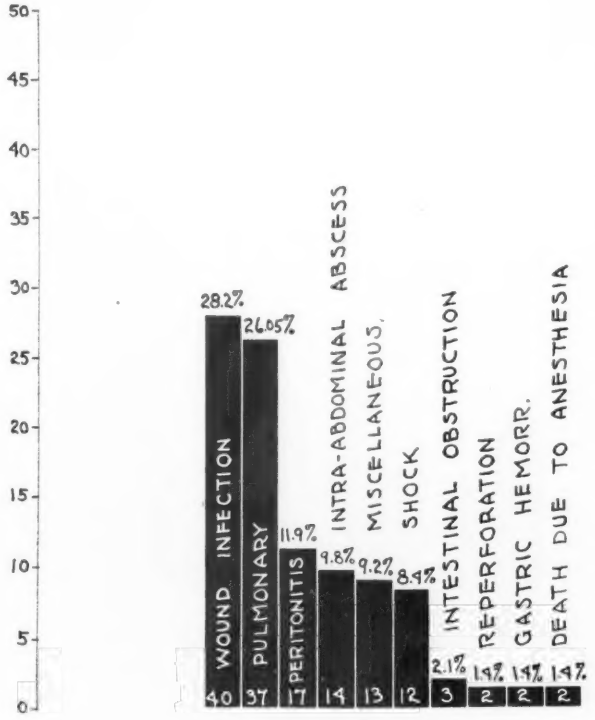

CHART 5.—Complications.

that this is a chemical rather than a bacterial peritonitis,[1, 3, 29, 30] one can take time to prepare the patient properly[13] before surgery is instituted.

When operation has been decided upon, careful consideration should be given to the anesthesia. The agent best suited to the individual patient must be used. Instead of having anybody "pour the ether," a competent anesthetist should be in charge at every operation. Preoperative medication must be administered with caution. It is the impression of one of us (H. B. O.) that two patients died because of administration of excessive doses of morphine.

The following outline for the general management of perforated peptic ulcer is presented:

1. Obtain the clinical history and make physical examination. Evaluate the patient's general condition.

2. Introduce gastric suction.

3. Place the patient on his left side for the purpose of demonstrating obliteration of liver dullness and preparatory to taking a roentgenogram to show pneumoperitoneum.

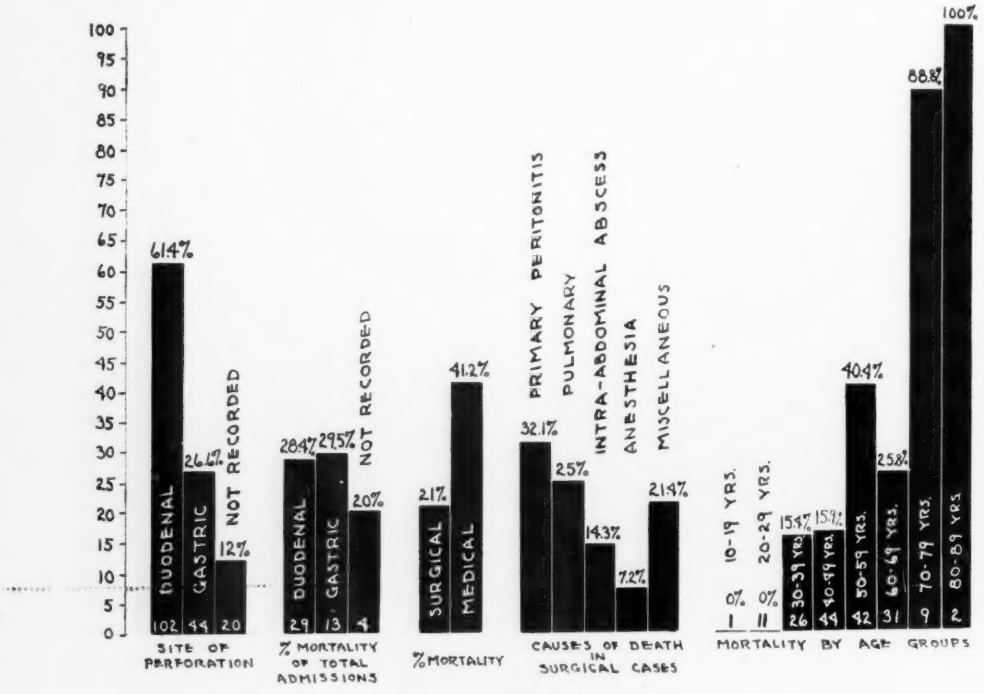

CHART 6.—Mortality statistics.

4. Administer an opiate sufficient to keep the patient fairly comfortable, but excessive amounts must definitely be avoided.

5. Laboratory work should consist of the following: Hematocrit determination, complete blood count and urinalysis, serum protein determination, and albumin-globulin ratio. It is not necessary to determine the blood ascorbic acid level if the patient is given at least 500 mg. of this vitamin before surgery.

6. Administer intravenous fluids of 5 per cent glucose and saline, as well as plasma or blood transfusions, depending upon the hematocrit reading and plasma findings. If possible, delay operative intervention until hypoproteinemia and anemia have been largely corrected. Spinal anesthesia is

preferred because it gives good relaxation, which is conducive to the least trauma in performing the operation. A trained anesthetist should be responsible for this important part of the operation.

7. Begin penicillin and sulfonamide drugs therapy if indicated.

8. Make a short incision directly over the distal end of the stomach and duodenum. If the diagnosis is clear, a transverse incision should be made. But if one suspects another lesion, a vertical incision is better, as this can be extended. Introduce methylene blue through the Levine tube if the perforation is not readily found.

9. Limit the surgical procedure to closing the perforation, preferably with a living tag of omentum. If this is not possible, a piece of omentum may be excised and used as a patch. Use only three or four sutures, inserted widely, according to the method of Graham.

10. Postoperative Treatment:

a. Continue gastric suction;

b. Administer fluids intravenously from 2,500 to 3,500 cc. daily. Add amino-acids and give blood transfusions and plasma if indicated;

c. Give ascorbic acid from 300 to 500 mg. daily.

d. Encourage the patient to move freely in bed, and cough if he has mucus.

e. Oxygen should be given before, during, and after surgery as indicated;

f. Check serum protein levels.

g. Continue penicillin or sulfonamide therapy if indicated.

SUMMARY

1. A study of 166 instances of perforated gastric and duodenal ulcers, collected from the records of the King County Hospital, Seattle, Washington, over a seven-year period is presented.

2. An outline of management is presented which, it is hoped, will reduce the surgical mortality of perforated peptic ulcer.

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CONGENITAL STENOSIS OF SMALL INTESTINE: WITH RETENTION OF NONPENETRATING FOREIGN BODIES

REPORT OF TWO CASES

McCHORD WILLIAMS, M.D.*

CHARLOTTE, N. C.

CONGENITAL STENOSIS of the small intestine is an extremely rare condition. In 1941, only 22 cases of stenosis of the intestinal tract had been seen at the Children's Hospital, Boston.[1] According to Loitman,[2] stenosis is more uncommon than atresia of the intestine, though, according to Hancock,[3] the reverse is true. Atresias occur once in 20,000 births, according to Webb and Wangensteen.[4] The duodenum is the most common site of stenosis, the ileum being involved next in frequency.

A search of the literature revealed only one case of retention of a foreign body as a result of congenital stenosis. This case was described briefly by Ladd and Gross,[1] under the discussion of foreign bodies in the intestinal tract and it served as a basis for an indication for operative intervention in cases where foreign bodies do not progress down the intestinal tract. Because the case had not been fully described it is being included as Case 1, through the kind permission of Dr. Robert E. Gross.

CASE REPORTS

Case 1.—A. D., a five-year-old child, was admitted to the Children's Hospital, Boston, February 23, 1927, because of persistent vomiting. The patient had been well until six months before admission, when he began to lose weight. Three weeks before admission he began to vomit intermittently. Vomiting became more frequent, and the child complained of severe cramp-like abdominal pains. These pains lasted five to six minutes and were relieved by abdominal massage and vomiting. The child's bowels had been loose during the five weeks prior to admission.

The family and past history were noncontributory.

Physical examination revealed a fairly well-developed and well-nourished child, slightly dehydrated. The abdomen was soft and tympmanitic. There was no spasm or rigidity. A vaguely outlined mass was palpated descending in the midline to the left of the costal margin for a distance of about 5 cm. Laboratory studies were within normal limits.

A roentgenogram of the abdomen was taken on the day following admission. This revealed in the region of the cecum a foreign body which had the appearance of a small coin. Thereafter a series of roentgenograms were taken until March 20, at which time no progress in the passage of the foreign body was noted. On that date the patient's abdomen became distended and he vomited repeatedly.

Operation.—March 21, 1927: Twenty centimeters below the ligament of Treitz a constriction was found in the jejunum which held the foreign material in place. The jejunum was dilated above the point of obstruction. The foreign bodies were displaced upward, an enterotomy was done, and a penny, a split button, and a nonabsorbent lozenge were removed. The stenotic area was then resected and side-to-side anastomosis done.

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Pathologic examination revealed the stenotic area to be 2.5 cm. in circumference when opened. There was some hypertrophy of the muscular wall. No inflammatory reaction was noted which might have caused the stenosis.

The patient's postoperative course was uneventful; was discharged on April 4, 1927.

Case 2.—F. B., a 26-months-old male infant was admitted to Walter Reed General Hospital, May 30, 1945, because of repeated crampy abdominal pains and vomiting of 24 hours duration.

The past history revealed that the patient was delivered normally at full term. Soon after birth he had a profuse hemorrhage by rectum. The bleeding was treated with transfusions and parenteral fluids. The infant developed abdominal distention, and intestinal obstruction was suspected. After hospitalization for about three weeks the patient improved. At the age of three monhs, however, his liver was palpated 4 cm. below the costal margin, he was slightly jaundiced, and there was a rachitic rosary present. Diagnoses by the attending pediatrician included mild rickets, anemia, gastro-intestinal anomaly, and vitamin deficiency. The patient improved under treatment, though his abdomen became distended intermittently.

At the age of 17 months the infant developed diarrhea and was treated in the Outpatient Department of Walter Reed Hospital. At that time his abdomen was distended. A gastro-intestinal series, taken August 31, 1944, revealed a foreign body, a metallic nut, measuring about one centimeter in diameter, in the abdomen. There was no evidence of intestinal obstruction or of megacolon. There was a slight hypochromic anemia, and a blood lead determination was reported as being within normal limits. It was felt that the foreign body would pass, and no further attention was paid to it. *Lamblia intestinalis* were found in the stools, and the patient was treated with atabrine, resulting in improvement. However, his abdomen became distended intermittently and only small amounts of food could be taken at each feeding.

Physical examination on admission to the hospital because of vomiting revealed a fairly well-nourished infant of 26 months, with a soft, distended abdomen and visible peristalsis. A roentgenogram of the abdomen revealed the metallic foreign body still present in the abdomen after an interval of nine months. There was no characteristic picture of intestinal obstruction. Following one night's observation, during which time parenteral fluids were administered, a repeat roentgenogram of the abdomen revealed a single dilated loop of small intestine.

Operation.—May 31, 1945: On opening the abdomen many dilated bluish loops of small intestine were encountered. Exploration of the abdomen revealed a smooth, firm mass of tissue, measuring 5 to 6 cm. in diameter, in the mesentery of the involved intestine, with many adhesions. One band was constricting the mesentery of a section of about 50 cm. of ileum as well as the lumen of the ends of the loop. This adhesion and several others were divided between clamps and ligated. Further exploration revealed a narrow portion of ileum distal to the strangulated area, which measured about 1.5 cm. in diameter. The wall was of normal thickness and showed no evidence of inflammation. The colon was completely collapsed. After release of the adhesions gas was seen passing into the colon. No evidence of the foreign body was noted, unless it could have been contained in the mass in the mesentery. The operation was interrupted on two occasions because of severe shock. The patient's condition improved during the administration of a transfusion through the jugular vein. After release of the adhesive band, the color of the involved ileum improved remarkably. After reduction of the intestines, the wound was closed in layers with interrupted silk. Convalescence was uncomplicated and the patient was discharged from the hospital on June 8, 1945.

Following discharge from the hospital the patient did well, though the abdomen remained distended, and he did not gain weight.

The child was readmitted to the hospital, September 24, 1945, for relief of partial

intestinal obstruction. He was prepared for operation with three grams of sulfasuxidine by mouth, daily, for four days, and a transfusion of 250 cc. of citrated blood. A roentgenogram of the abdomen revealed the same foreign body in the right lower quadrant of the abdomen.

Second Operation.—September 29, 1945: The small intestine was found to be widely dilated. Exploration revealed no mass in the mesentery. Numerous adhesions were divided, and the point of stenosis was located at a site about 30 cm. above the ileocecal valve. Its appearance is shown in Figure 1A. Above the area of stenosis the ileum was dilated to about four times its normal diameter, and below it the ileum and colon were collapsed. The foreign body was palpated, free in the lumen of the

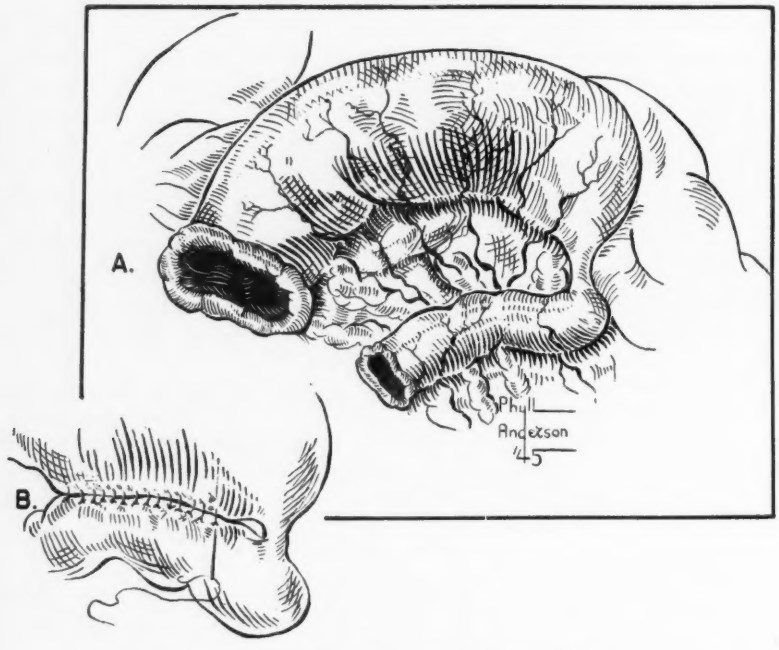

FIG. 1.—Case 2: (A) Area of stenosis of ileum.
(B) Entero-enterostomy.

ileum, about 25 cm. above the area of stenosis. An entero-enterostomy was then performed, side-to-side, between areas just proximal and distal to the area of stenosis, as shown in Figure 1B. On completion of this procedure two fingers could be passed easily through the stoma, and it was felt that the foreign body would pass spontaneously through the opening. Since the child's condition was not particularly good, prolonging the procedure for removal of the foreign body was considered inadvisable, and the abdomen was closed.

The postoperative course was uneventful. Wangensteen suction was discontinued after four days, and the patient began to take fluids without vomiting. All stools were examined; the foreign body was not found. A bulky diet was given, and on the ninth postoperative day a gastro-intestinal series was made. This revealed the foreign body low in the right lower quadrant. Its position was not changed by passage of the barium. The patient was discharged from the hospital October 14, 1945. Following discharge the patient gained weight and the distention completely subsided.

On October 28, 1945, one month after the second operation, a roentgenogram of the abdomen revealed the metallic nut still present. The patient was readmitted to the hospital, and, on the following day, the third operation was performed through a small incision. The entero-enterostomy was found to be widely patent, admitting two fingers with ease. The foreign body was found lying in the stenotic area. It was displaced upward, removed, and the ileum was closed. The postoperative course was uneventful, and the patient was discharged November 3, 1945.

DISCUSSION.—In neither of these cases was an hyperchromic anemia noted, such as has been described by Meulengracht,[6] Deutsch,[7] and others, occurring with benign stenosis of small intestine.

In Case 2, the profuse gastro-intestinal hemorrhage, which occurred soon after birth, may have been the result of rupture of a congenital diaphragm occluding the intestine, as described by Loitman,[2] Ladd and Gross,[1] and others.

According to Ladd and Gross,[1] entero-enterostomy is the procedure of choice in the treatment of congenital stenosis of small intestine. In Case 2 it is apparent that the foreign body should have been removed at the time of entero-enterostomy.

It is interesting to note that the nonpenetrating foreign body remained free in the lumen of the intestine for 14 months. The strangulation obstruction was related, perhaps, to the congenital stenosis by lengthening of the mesentery in the chronically distended intestine, and by an inflammatory reaction with formation of adhesions secondary to distention and its attendant congestion of circulation. The mesenteric mass, which disappeared between the first and second operations, must have been enlarged lymph nodes due to congestion.

SUMMARY

1. Two cases of congenital stenosis of small intestine, with retention of nonpenetrating foreign bodies, are presented. No other cases of this description have been found in the literature.
2. As has been pointed out by Ladd and Gross,[1] children who have ingested blunt foreign bodies which have entered the stomach should be followed by repeated roentgenograms of the abdomen until the foreign material has passed. In case of undue delay, abdominal exploration should be performed.
3. The diagnosis of congenital stenosis of small intestine should be considered in infants and small children who have been troubled with recurrent abdominal distention since birth.

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FAMILIAL DIVERTICULOSIS OF THE COLON

REPORT OF SEVEN CASES IN ONE FAMILY OF NINE PERSONS

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DIVERTICULOSIS OF THE COLON is a condition that has been recognized by anatomists for centuries. Only during the past thirty years, however, has the study of the gastro-intestinal tract by means of contrast radiograms called to our attention the relative frequency of this malady. The true importance of diverticulosis of the colon as a cause of intestinal obstruction, peritoneal infection and chronic colitis is now well recognized. There is also general agreement as to the best methods of treatment and these are well known. In the question of etiology remains the greatest diversity of opinion.

Diverticulosis of the colon in universally accepted as being an herniation of the mucosa and submucosa of the intestine through a defect in its circular muscle layer. There are several schools of thought on why this phenomenon occurs. One group of investigators believes that diverticula of the colon may develop essentially as the result of a combination of physical forces. This usually consists of a weakening or spreading of the circular muscle layer of the bowel at the points of entrance of its blood vessels by an increase of intracolic pressure due to constipation, muscular spasm, or other causes. This view is shared by Ceballos,[1] Dixon,[2] and Edwards.[3] A different opinion is expressed by Fansler,[4] who believes that degenerative changes occur in the muscle layer near middle age which makes damage by traumatization of hard stools and gas distention more easy. He does not believe that diverticula develop at the points of vascular penetration. Wierda[5] believes that diet may be a factor in etiology since he found diverticulosis of the colon in three rats fed on a high fat diet. Then, there is the belief that before a diverticulum can be formed there must exist a congenital anatomic deficiency in the wall of the colon which will act as a starting point. This view is held by Poate,[6] who has noted the presence of diverticulosis in young people before the age at which degenerative changes take place. Likewise, Erdmann[7] has reported a case of diverticulosis of the colon in a boy 11 years old, and he states that he has knowledge of other cases occurring in children, and, thus, believes that there is a congenital factor in etiology. Badia[8] has reported a case of diverticulosis of the colon in a 14-year-old boy, which he feels must be due to a congenital weakness in the muscular coat. Cave[9] believes that an inherent weakness in the muscle fibers is an underlying cause of diverticulosis. Bearse[10] states that the most likely causes of diverticulosis in young adults are probably structural defects in the colon which may be congenital. He further states that a tendency to

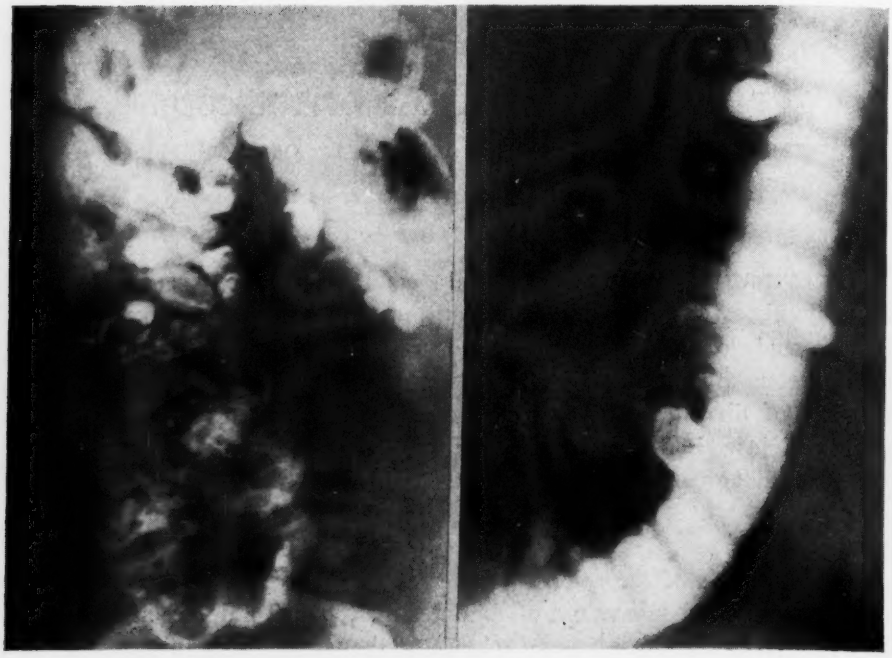

FIG. 1 FIG. 2

FIG. 1.—Case 1: Ascending colon and hepatic flexure with multiple diverticula.
FIG. 2.—Case 2: A portion of the descending colon with many large herniations.

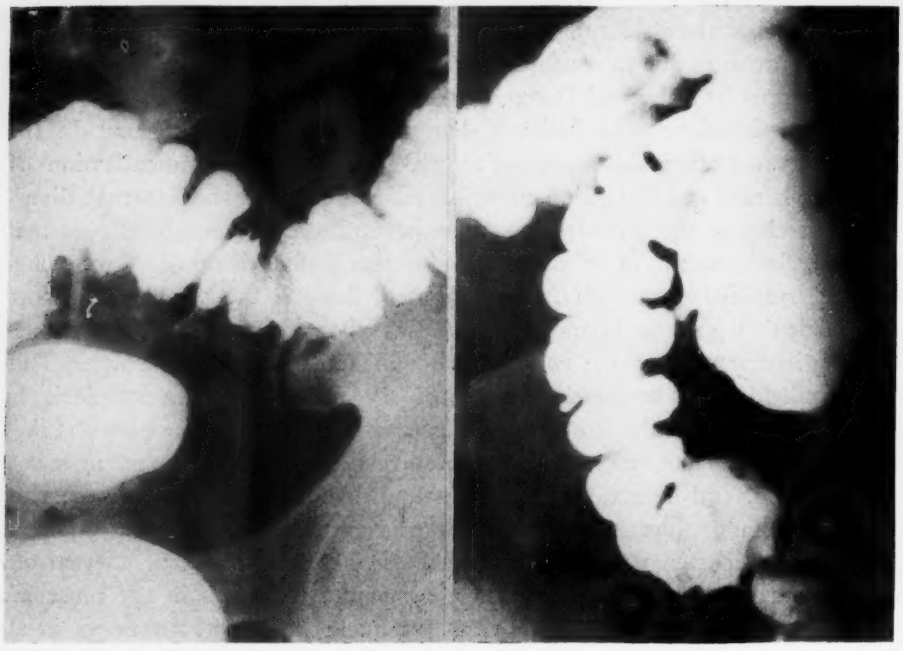

FIG. 3 FIG. 4

FIG. 3.—Case 3: Diverticula of the sigmoid colon.
FIG. 4.—Case 4: Region of the splenic flexure of the colon with diverticulosis.

diverticulous formation may be inherited, and cites one of his cases whose father also had diverticulosis of the large intestine.

If diverticulosis of the colon actually does develop upon preëxisting congenital defects in the structure of the bowel it would follow that such defects could be a familial trait, and, thus, several cases of diverticulosis might develop in members of one family. It is the purpose of this paper to report just such an occurrence.

FIG. 5

FIG. 6

FIG. 5.—Case 5: Part of the descending colon with diverticula.
FIG. 6.—Case 6: Diverticulosis of the colon at the splenic flexure.

Herewith is a report of the presence of diverticulosis of the colon in seven full brothers of one white family that consists of seven males and two females. After two members of this group had developed symptoms referable to the colon and each was found to have diverticulosis involving the entire large bowel, a study was made of the remaining brothers and sisters. Each of these was requested to fill out a comprehensive history form pertaining to the gastro-intestinal tract. Radiograms of the colon were obtained in each case after the administration of a contrast enema or after the ingestion of contrast media. These individuals reside in widely separated parts of the Pacific coast area, and the radiograms were made in different

laboratories and under varying conditions. All of the original radiograms were studied by Walter L. Stilson, M.D., Radiologist, of Los Angeles, California.

CASE REPORTS

Case 1.—A. D. S., a Washington physician, age 67, height 66 inches, weight 220 pounds, was in active practice when symptoms of acute peritonitis developed in 1941. Celiotomy revealed the presence of an abscess in the lower left abdominal quadrant, which proved to be secondary to a perforated diverticulum of the sigmoid flexure of the

FIG. 7

FIG. 7.—Case 7: Diverticula of the sigmoid colon.

colon. Drainage was accomplished, and recovery followed. Contrast radiograms demonstrated the presence of multiple diverticula of the entire colon. Figure 1 shows the ascending colon and hepatic flexure in this case with innumerable diverticula filled with the contrast media.

Case 2.—J. A. S., a California salesman, age 64, height 71 inches, weight 225 pounds, suffered vague digestive disturbances for many years. The main complaints were indigestion, flatulence and diarrhea associated with pain in the lower left abdominal quadrant. Radiologic studies of the colon revealed the presence of over 50

diverticula, with involvement of the entire large bowel. Figure 2 shows a part of this man's descending colon which contains many very large herniations. Almost complete relief of symptoms was obtained through medical treatment.

Case 3.—H. A. S., a central California poultryman, age 70, height 69 inches, weight 165 pounds, was studied after two of his brothers (Cases 1 and 2) were found to have diverticulosis. A contrast enema showed many diverticula of the descending colon. Figure 3 demonstrates one large and several small diverticula in the sigmoid region of this man's large bowel. There was no history of constipation, flatulence, or other evidence of the definite pathology that existed.

Case 4.—D. A. S., an Idaho farmer, age 68, height 62 inches, weight 132 pounds, was studied during the routine family survey. There was no history of constipation, gas formation, or other gastro-intestinal disturbance. The contrast enema showed the presence of diverticulosis of the descending colon. Figure 4, taken from the region of his splenic flexure, shows several of the diverticula filled with barium mixture.

Case 5.—J. H. S., a retired California railroad brakeman, age 55, height 72 inches, weight 227 pounds, experienced severe indigestion in 1938. A diagnosis of peptic ulcer was made and a diet was prescribed, with successful results. There has been no recurrence of symptoms. No history of constipation was obtained. A routine radiogram proved the presence of diverticulosis of this man's descending colon, a part of which is seen in Figure 5.

Case 6.—C. R. S., a California lumber mill employe, age 52, height 74 inches, weight 160 pounds, had enjoyed good health with no history of constipation, flatulence, or other disorder of the gastro-intestinal tract. Figure 6 shows his colon at the splenic flexure, with several diverticula in evidence.

Case 7.—E. E. S., a central California lumber executive, age 49, height 71 inches, weight 195 pounds, gave no history of intestinal abnormality other than hemorrhoids. The routine contrast enema revealed many diverticula of his descending colon. Figure 7 shows several of the herniations in the sigmoid region.

In the two female members of the family no evidence of diverticulosis could be found, either by careful history or by radiologic examination. One sister was completely bedfast because of advanced cardiac decompensation and radiograms made with a small portable machine in the home were not entirely satisfactory.

COMMENT: That seven brothers in one family of nine persons could be afflicted with diverticulosis of the colon may of course be a coincidence, but it is not likely. This series of seven cases represents 100 per cent of the male members and 78 per cent of the entire family that was studied. These figures are interesting when compared to the incidence of diverticulosis of the colon in the general adult white population which is estimated to be between 2 per cent and 5 per cent. In the group of cases here presented there is a wide variation in the size and weight of these men as well as in their places of abode, occupations, social status, and in their habits of living. There is no apparent common factor of etiology other than ancestry.

From the evidence which has been presented it is apparent that heredity cannot be disregarded as an etiologic factor in the formation of diverticula of the colon. It is logical to believe that there must be a congenital anatomic defect in existence before the mucosa and submucosa can herniate through

the muscle layer of the intestine; even as a congenital defect in the abdominal wall is usually necessary for the formation of an inguinal hernia.

SUMMARY AND CONCLUSION

1. Diverticula of the colon are herniations of the mucosa and submucosa through defects in the muscle layer of the bowel, usually at the points of entrance of blood vessels.

2. Prevailing beliefs as to why this occurs include: (a) physical forces; (b) degeneration of the muscle layer incident to age and trauma; (c) diet; and (d) the presence of congenital defects in the bowel wall.

3. Reports are presented of seven cases of diverticulosis of the colon in one family of nine persons.

4. The conclusion is reached that heredity should be included as a major causative factor in the etiology of diverticulosis of the colon.

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CARCINOMA OF MECKEL'S DIVERTICULUM

CASE REPORT

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Carcinoma of Meckel's Diverticulum has been reported at infrequent intervals and the total number to the present time is small enough to make an additional case of interest. It is rare enough that no one individual has reported more than one case. A few isolated cases of tumors of this congenital anomaly, other than carcinoma, appear in the literature.

For the origin of the diverticulum we must consider the embryologic development of the fetus. Towards the end of the second week of embryonic life there develops a spherical sac with a wide opening into the intestine. This is known as the yolk sac, and during the third week of fetal life it becomes constricted-off from the embryo, maintaining one connection known as the yolk stalk. This stalk is also known as the vitelline or omphalomesenteric duct. Complete closure of the stalk usually occurs around the fifth week of intra-uterine life. Incomplete obliteration of the stalk explains the formations of the congenital anomaly, Meckel's diverticulum. According to Nygaard and Walters, Meckel's diverticulum is found in about 2 per cent of all adults. It is usually situated in the ileum at a distance of 25 to 100 centimeters from the iliocecal valve on the antimesenteric border. The length of the diverticulum, as well as the size of the lumen, may vary considerably. Ordinarily, the end is free but at times it may be adherent to the abdominal wall, the adjacent viscera or the mesentery, and at times this may be the cause of strangulation of the intestines.

Histologically, it usually contains all the cellular elements which make up the intestinal wall of the ileum. This generally consists of four coats, although, according to Reiser it usually lacks the circular musculature. The mucosa resembles ileum and includes villi and intestinal glands. However, in about 15 per cent it may have mucosa of the gastric type, generally of the fundic variety and in rare instances it may resemble mucosa of the colon and even include pancreatic tissue. Thus, in addition to the tumors arising from the normal cellular elements others arising from foreign or aberrant tissue elements, may be encountered.

In 1942, Albright and Sprague gathered six previously reported cases of carcinoma occurring in Meckel's diverticulum, and to this collection they made an addition of one case of their own. Of these seven cases, five were identified as adenocarcinoma and two as medullary carcinoma. Included in those classified as adenocarcinoma is one reported by Gray and Kernohan which was shown to have its origin in gastric mucosa within the diverticulum. All of these specimens were obtained from surgical cases in which removal of the diverticulum, portions of small intestine and metastatic areas were accomplished. In all but one of these above cases the

patient survived the operation. In the case of Wisely the patient died three days postoperative, and an autopsy performed showed no metastasis. I can find no other record of follow-up. The immediate results in all were very good.

In addition to the above there has been one other case of carcinoma of Meckel's diverticulum which was reported by Weir in 1937. This was not

FIG. 1.—Gross specimen showing diverticulum (X) unopened.

included in the seven reported by Albright and Sprague. In this instance an autopsy was also performed and extensive metastases were found studding the peritoneal surfaces, in the omentum and liver. It had also infiltrated the mucosa of the jejunum. Histologically, it was a highly anaplastic new growth with abortive attempts at the formation of glands. The addition of this case, therefore, brings the total number of adenocarcinomas previously reported to six.

In addition to the carcinomas there have been several other types of tumors, benign and malignant reported as arising in Meckel's diverticulum. Nygaard and Walters found 14 cases of sarcoma in a total of 20 cases of malignant tumors. Weir, in his review, also mentions five cases of carcinomoid tumor. Thus, the various types found are more or less equally divided.

Clinically, it is very difficult to make a diagnosis of tumor of Meckel's diverticulum before operation or necropsy. The most common presenting symptoms would lead to the impression of an acute pathologic lesion in the abdomen. The tumor itself may or may not be palpable, although the symptoms do not depend on the size of the tumor. Secondary complications such as intestinal bleeding, intussusception, obstruction or perforation, with either local or diffuse peritonitis, may be responsible for calling at-

FIG. 2.—Gross specimen showing diverticulum (X) opened with tumor filling the lumen.

tention to the condition. In six cases the lesion was demonstrated roentgenologically.

Most of the above symptoms may also be caused by a nonmalignant lesion of the diverticulum. It may give rise to obstruction, intussusception or ulceration without containing a tumor mass. These benign inflammatory lesions greatly outnumber the malignant lesions. They present the same group of symptoms and in some cases a mass may also be felt.

Case Report.—The patient, W. R., a 55-year-old colored male, was admitted to the Veterans Administration Facility at Hines, Illinois, June 12, 1945 at 8:00 P.M., for the treatment of acute appendicitis. His past and military history were irrelevant. He did not recall any previous illness of importance and had had no operations. There

was no history of gastro-intestinal or genito-urinary trouble. On admission, he stated that he had pain in his stomach about three weeks before. He called his physician who told him he had appendicitis and cystitis. At this time he reported to the Out-patient Department of this hospital, where a diagnosis of appendicitis, subsiding, was made and he was placed under the care of his own physician with instructions to return if he had a recurrence.

The patient returned to his work and was apparently well until 6:00 P.M., June 12, 1945. At this time, he developed an acute, sharp pain in his stomach and he was

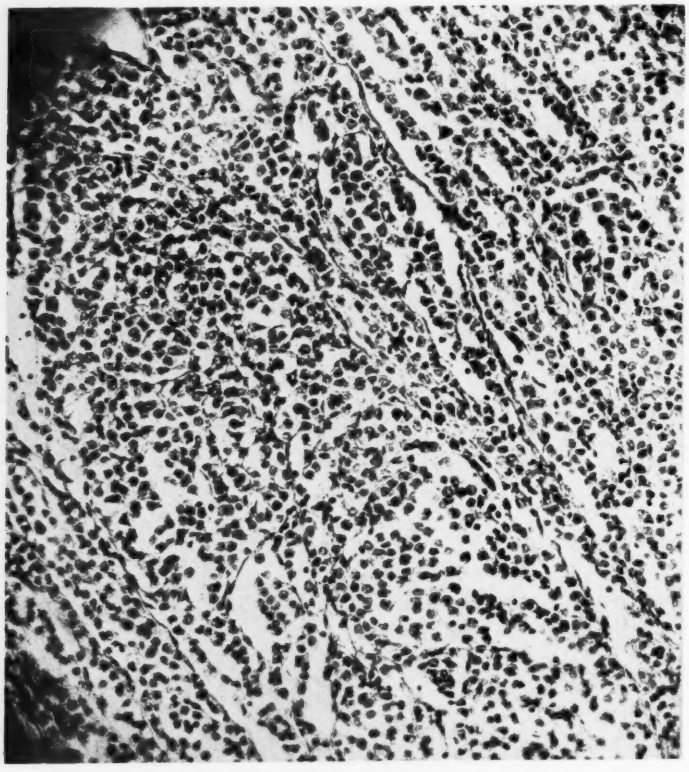

FIG. 3.—Photomicrograph showing tumor cells tending to form gland-like structures. (x 300)

given first-aid by the doctor at the post office where the patient was an employee. He was brought to this hospital immediately by ambulance.

On his arrival he was seen by the surgical consultant. Examination at this time showed his abdomen to be slightly distended but not rigid. There was tenderness over the entire lower abdomen but it was more marked on the right side. Rebound tenderness was also elicited. There were no palpable masses. Laboratory studies showed W.B.C. 19,200, with 90 per cent polymorphonuclears and 10 per cent lymphocytes; R.B.C. 4,600,000, with 90 per cent hemoglobin. The urinalysis was negative.

Operation.—Under spinal anesthesia, the abdomen was opened, and about two ounces of seropurulent material escaped. The mesentery of the appendix was clamped but on exposure the appendix was apparently normal. However, it was removed. Exploration then revealed a tumor mass of the ileum which was adherent to the anterior parietal wall. This mass was freed by blunt dissection and brought out through the operative incision. It was approximately 18 inches from the cecum and about 7 cm. in diameter.

The surrounding tissue and intestine were apparently normal. The growth was exteriorized for later removal. The postoperative diagnosis was tumor of the ileum, type undetermined, and peritonitis.

The patient was returned from the operating room to the ward in good condition. He was given intravenous fluids and sulfadiazine in addition to the routine postoperative care. There was a great deal of abdominal distention which was difficult to control. At one time during dressing of the wound flatus escaped from the exteriorized tumor. There was also fecal drainage. On June 19, 1945, he began complaining of shortness of breath and his pulse was weak. The respirations gradually became labored and he expired at 6:35 P.M., June 19, 1945.

Autopsy.—External examination showed a well-developed and well-nourished white male. The abdomen was distended and tympanitic. In the right lower quadrant there was a recent surgical wound. In the central portion of the incision a mass attached to small intestine had been exteriorized.

Intestinal Tract: There was no peritonitis. There was a marked ileus with distention of the entire small bowel above the exteriorized mass. The appendix had recently been removed. Examination of the tumor mass itself showed that it was a diverticulum located 24 inches above the cecum. It measured two inches in length and two and one-quarter inches in diameter. Its opening was the same size as the lumen of the small intestine. Grossly, it was a purplish-red color and there was a small fistulous opening at its tip. On cut-section it was seen that most of the diverticulum was made up of a firm, grayish-white tumor. It was quite homogeneous for the most part but there were small areas of cystic change or necrosis.

Examination for metastases revealed no involvement of the lymph nodes. The liver contained a great many umbilicated tumor nodules. These were firm, white in color, and well-demarcated from the surrounding liver tissue. They measured in cross diameter about two to three centimeters each, and a good many of them showed central necrosis.

Microscopic Study of Tumor and Metastases. The sections showed an extensively infiltrating new growth. The cells varied in size and shape but in a good many places were definitely of cuboidal and columnar structure and were arranged in acinus formation. There were moderately hyperchromatic and an occasional mitotic figure was seen. There was a loose fibrous tissue supporting stroma. There was an occasional mitotic figure. The lining cells of the diverticulum were definitely columnar. There was some edema of the mucous covering with slight infiltration of round cells.

In the liver there were metastases which presented the same general histologic pictures as the tumor noted in the diverticulum. However, the tendency towards glandular structures was less pronounced. The tumor cells were more dense and there was more fibrous tissue.

SUMMARY

There is presented as an addition to the literature a case of carcinoma of Meckel's diverticulum. Previously, seven cases had been reported by Albright and Sprague, and another was added by Weir. This case brings the total number of adenocarcinomas to seven, of which one originated in gastric mucosa. Two medullary carcinomas now bring the total number to nine.

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ENTEROGENOUS CYSTS

REPORT OF CASE INVOLVING THE RECTUM

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ENTEROGENOUS CYST is a term applied to congenital cysts arising from the gastro-intestinal tract and occurring in any part of the tract from the esophagus to the anus.[19] This definition has been broadened to include tubular duplications of the intestinal tract. Much confusion has arisen due to the use of a wide diversity of terms to describe this condition, such as enteric cyst, enterocystoma, ileum duplex, unusual Meckel's diverticulum, giant diverticulum, *etc.* In this paper, the authors will include all these terms under the single term of enterogenous cyst. An instance of this developmental anomaly involving the rectum will be presented, with a brief review of the literature and discussion of the etiology.

Classification.—Intra-abdominal cysts and mesenteric cysts may be classified as follows:

1. Congenital cysts:
   (a) Lymphatic or chylous cysts.
   (b) Enterogenous cysts.
   (c) Urogenital cysts.
   (d) Dermoids or teratoids.
2. Neoplastic cysts.
3. Inflammatory cysts, such as hydatid.

Discussion in this paper is limited entirely to those arising from the gastro-intestinal tract. The classification given above is a composite of those suggested by Ewing, Peterson and Parsons.[6, 16, 17]

The literature on enterogenous cysts is inseparable from that of the general class of mesenteric cysts. The confusion makes it almost impossible to determine the precise incidence of enterogenous cysts. Some idea of the rarity of the condition can be gained by a review of the incidence of mesenteric cysts. The reported cases of enterogenous cysts will be discussed more completely under the heading of treatment.

According to Roller,[18] the first cyst of the mesentery was found at autopsy in the 16th century and, since that time, the condition has come to be considered one of the rarest of abdominal tumors. It is usually stated that be-

tween 200 and 400 mesenteric cysts are reported in the literature. It is stated that no mesenteric cysts were found at the Los Angeles General Hospital from 1912 to 1929. Snyder[22] concurs in stating that mesenteric cysts are among the rarest of abdominal tumors, and quotes Judd that in 820,000 admissions to the Mayo Clinic 25 cases of mesenteric tumors were found, and only eight of these were cysts. The Massachusetts General Hospital reports only six cases from 1900 to 1926.

As far as the location of enterogenous cysts is concerned, over half the cases occurred in the small bowel and, of these, about half in the ileum.[23] Dockerty, Kennedy and Waugh[4] state that 85 per cent of enterogenous cysts involve either the cecum or ileum, and that the symptoms are usually obstructive. Ladd[12] has reported a series occurring as follows: four of the ileum, and one each of the stomach, duodenum, jejunum, mediastinum, upper lobe of the lung, and the tongue.

By personal communication, it has been found that the Army Institute of Pathology, Army Medical Museum, Washington, D. C. has three cases of enterogenous cyst on record. Two of these involved the mesentery of the ileum and were in infants less than one year old. The third case occurred in a 31-year-old white male, and involved the mesentery of the lower ileum. This institute had no enterogenous cysts involving the large bowel.

Enterogenous cysts of the rectum are extremely rare. McClanahan and Stone[15] report two cases, Hullsiek[11] reports four cases, and Ladd and Gross[14] report one case.

Embryology.—Enterogenous cysts present a wide variation in location, size, shape, relation to the intestinal wall and lumen, and relation to the mesentery. No single theory as to their origin can satisfactorily explain all the cases observed. There are three different theories concerning the embryogenesis of enterogenous cysts or intestinal duplications, which, between them, can adequately account for the gamut of variations noted clinically.

An often suggested mode of origin for enterogenous cysts is that they result from aberrations in the development of a Meckel's diverticulum. This fairly common diverticulum is the persistent vitelline duct, originally connecting the yolk sac and the intestinal tract. It usually arises from the antimesenteric portion of the terminal ileum, is normally obliterated before birth, but persists in about 2 per cent of people. It is conceivable that abnormalities in the development of Meckel's diverticulum may cause it to be pinched-off and, thus, give rise to enterogenous cysts or intestinal duplications, which may or may not communicate with the intestinal lumen. A considerable proportion of enterogenous cysts arise in the ileocecal region, and this mode of origin is a plausible explanation for their development. However, it does not explain those cases located along the tongue, esophagus, duodenum, colon or rectosigmoid, nor does it explain those cases which have separate mesenteries.

A second mode of origin, that has been stressed by Ladd and Gross,[14]

and others, is based on an observation by Lewis and Thyng, in 1907, who reported frequent diverticula at various levels of the fetal intestinal tract in the pig, rabbit, and man. These diverticula are found in 20-to-30-mm. embryo (eight–nine weeks), usually on the antimesenteric border, and normally disappear completely. It is not difficult to visualize how such a residual outpouching can become pinched-off and give rise to cystic structures with the histologic components of the intestinal wall. They may be located anywhere from the mouth to the anus; they may be in a submucous, intramural, subserous or intramesenteric position; and they may communicate with the bowel or be completely separated from it. However, this mode of origin will not explain the long tubular intestinal duplications that have been observed by Ladd and Chisholm, and Feingold and Shulman,[13, 7] nor those that have a separate mesentery or more than one communication with the bowel lumen.

A third mode of origin has recently been described by Bremer.[2] In the 10 mm. embryo (about six weeks) just prior to the rapid lengthening of the intestinal tract there is an hyperplasia of the epithelial cells producing a marked reduction in the size of the lumen, or even occluding it. This solid stage may occur at any point along the intestinal tract. These epithelial cells secrete a fluid which forms small vacuoles. These vacuoles gradually coalesce and reform the lumen of the tube. In rare cases a chain of vacuoles may coalesce but not reunite with the main lumen, producing two separate lumens. As growth progresses the two lumens become more separated and each comes to be surrounded by a submucosa and muscular layer. Thus, there is produced a double-barrelled tube or duplication of the intestinal tract. The duplicated portion may be a long tubular structure or it may be short and rounded; it may be within the wall of the intestine or completely separated from it even to the point of having a separate mesentery; it may communicate with the intestinal lumen at both ends, at one end, or be completely sealed off.

It is very likely that any of the above-mentioned anomalies of development may give rise to enterogenous cysts. The structure ultimately found clinically is the result of superimposed factors such as hemorrhage, infection, intracystic pressure, blood supply, and relation to surrounding viscera.

Diagnosis.—As far as symptomatology and diagnosis of enterogenous cysts are concerned, no pattern of symptoms is presented with sufficient regularity to make preoperative diagnosis possible in a very high percentage of cases. Many reported cases have been operated upon because of acute intestinal obstruction of undiagnosed etiology and, at the time of celiotomy, enterogenous cysts have been found. This is particularly true of that series of cases occurring either in infants or very young children. Another group of cases does not present obstructive signs and symptoms but presents an undiagnosed abdominal tumor mass of a cystic nature which ultimately proves to be an enterogenous cyst. These cases are often adults in whom the condition remained asymptomatic for a long period of time and became

mildly symptomatic with increase in size and pressure of the cyst upon other organs.

Treatment.—Treatment of enterogenous cysts is obviously surgical; and one of the following procedures is recommended: (1) Resection. (2) Enucleation. (3) Marsupialization. Any plan of treatment must, of course, be governed by the condition of the patient at the time of operation and, if surgical conditions are not ideal for carrying out a complete eradication of the cyst, some form of palliative and temporizing procedure must be selected. This is particularly true of those patients who have developed acute intestinal obstruction as a result of a cyst, and in whom some form of decompressive measure as an initial operation may be the primary treatment of choice, followed at a later date by a more definitive surgical procedure. If the case is an elective one and surgical conditions are ideal, either resection or enucleation should be chosen, depending upon the location of the cyst and its attachment to the gastro-intestinal tract. If the attachment is such that the cyst cannot be completely eradicated and recurrence avoided, then resection of the cyst and the attached bowel, with some type of anastamosis to restore continuity, is preferable. In some cases enucleation is not only feasible but can be performed successfully with a high percentage of cure. Marsupialization is condemned by most authors and should be used only if no other form of surgical treatment can be followed. When used, it results in a greatly prolonged period of drainage and, very often, in recurrence.

Aschner[1] collected, and briefly reviewed, 27 patients from the literature, the majority of whom were children, mainly infants, and all involving the cecum or ileum. Seven were successfully operated upon. Drennen[5] reports three cases occurring in the ileocecal region. One was in a child, age nine months, suffering from acute intestinal obstruction; the cyst was located within the wall of the cecum and resection was performed with recovery. The second was a child, age two, with symptoms and signs of obstruction and bloody stools, who, upon operation, had an intussusception which was impossible to reduce. An ileosigmoidostomy was performed, with a fatal outcome, and the specimen showed a cyst of the cecum. The third was a woman, age 21, with a diagnosis of acute appendicitis, who had a cyst in the lower cecum which was removed without resection and with recovery. Gardner and Hart[8] report an enterogenous cyst of the duodenum in a girl, age 15, which was removed, and the patient recovered. Green[9] reports a boy, age six, operated upon for obstruction, who presented a cyst located in the mesentery of the transverse colon, which, histologically, showed the structure of the small intestine. This was treated by marsupialization, with recovery. Green[9] also reports a man, age 56, with a long history of right lower quadrant pain who, at operation, had a large enterogenous cyst attached to the terminal ileum. The cyst was removed, with recovery. Shallow[20] reports a male infant, age five months, who was admitted with enormous abdominal distention and obstruction. At operation, a very large cyst, containing

1,500 cc. of fluid, was found attached to the small intestine, and 10 cm. from the ileocecal junction. This was an enterogenous cyst, which was treated by a primary resection, with a fatal result. Carlson[3] reports an enterogenous cyst occurring in a male, age 22, with obstructive symptoms. The cyst was not removed, but two enterostomies were performed within 12 hours above the point of obstruction. The patient died and, at autopsy, was found to have an enterogenous cyst of the mesentery. Grove and Porch[10] state that resection is usually safer than attempting to remove the cyst from the bowel, and report a 22-year-old male who was operated upon with a preoperative diagnosis of acute appendicitis, but was found to have an enterogenous cyst located 40 cm. from the cecum and closely adherent to the terminal ileum. Resection and end-to-end anastamosis were performed, with recovery. Ladd[12] reports the following cases with their management: (1) A 35-day-old baby, with a cyst of the upper duodenum, which was resected and a posterior gastro-enterostomy performed; this case recovered. (2) A six-months-old infant, with a perforated duplication of the jejunum and peritonitis. Enterostomy was performed; the patient died. (3) A two-months-old female, with a duplication of the terminal ileum upon whom resection and end-to-end anastamosis was performed; with recovery. (4) A 19-months-old child, with a cystic duplication of the bowel and hemorrhage. The cyst was removed; the result is not stated. In these cases, reported by Ladd, vomiting was a prominent symptom in all, and a tumor mass was presented in six of seven abdominal cases. Ladd[12] states that the treatment is surgical, with no undue delay, and that seven of ten patients thus treated were relieved and three died. Sherwin[21] reports a female, age four years, with obstructive symptoms, who presented a tumor of the ileocecal junction; found to be an enterogenous cyst. This was treated by resection and anastomosis, with recovery. Sherwin[21] states that the first choice of treatment is enucleation, with resection as second choice and, lastly, marsupialization should be used if all other procedures are impossible.

Many writers state that the rectum is the rarest site for occurrence of enterogenous cysts. McClanahan and Stone[15] reported two cases originating from the rectum. The first case was a woman, age 48, with a cystic mass about the size of a walnut, located between the posterior wall of the rectum and the coccyx, about 5 cm. within the anal orifice. This was removed extraperitoneally by an incision posterior to the anus, with removal of the coccyx and dissection of the cyst from the posterior wall of the rectum. Pathologically, this was found to contain all layers of the intestine, with tall columnar epithelium of the mucus-secreting type. The second case was a male baby, age one month, who presented signs and symptoms of incomplete intestinal obstruction, with a mass covered with rectal mucous membrane projecting through the anus. This was treated first by aspiration, and later removed through an incision to the right of the rectum, enabling separation of the cyst from the rectal wall. This, too, revealed all layers of the intestine with a well-defined mucosa of columnar epithelium. Both cases

recovered. Hullsiek[11] reported four cases of enterogenous cysts of the rectum palpable as extrarectal masses and varying in size from a hazelnut to a walnut. All four of these were removed surgically from within the rectum. Of 18 cases reported by Ladd and Gross,[14] one was of the rectum, in a six-months-old infant, and measured 5 x 2.5 x 2.5 cms. This case was treated by excision of the cyst.

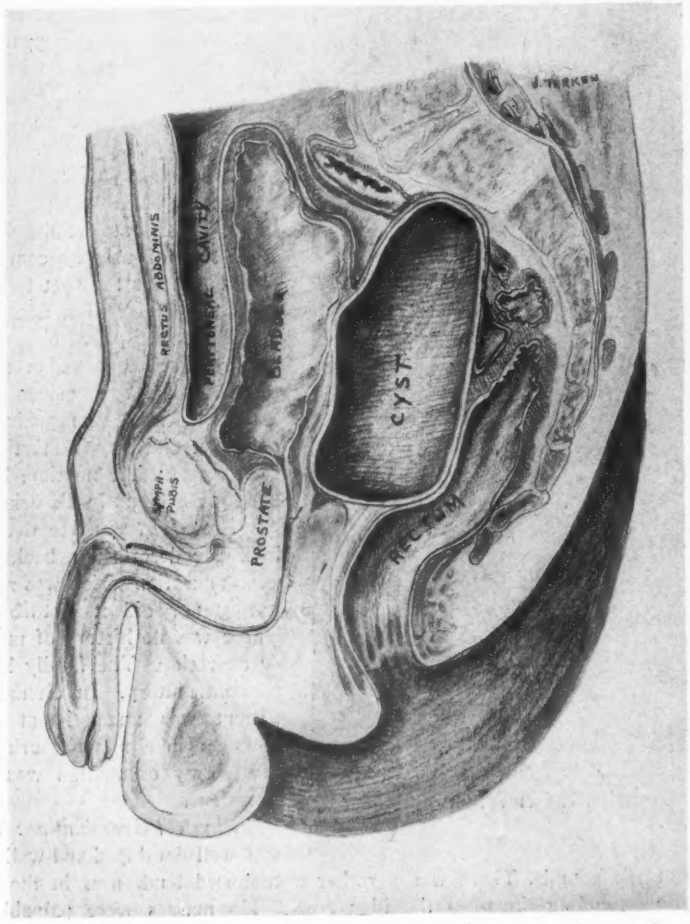

FIG. 1.—Lateral drawing showing cyst between bladder and rectum.

Case Report.—E. P. G., a 29-year-old, white male, complained of intermittent epigastric pain for 2.5 months prior to admission. His present illness began on March 4, 1945, about two hours after eating the evening meal, when he first noted severe epigastric pain, nausea and vomiting. The attack lasted about one and one-half hours, but epigastric soreness remained throughout the night. The following day he experienced a similar attack of epigastric pain which, he states, was relieved by an alkaline drink. On the third day, he developed an attack which was much more severe than the previous ones, and he was hospitalized at an Army General Hospital, where expectant treatment was given. Gallbladder roentgenologic study was reported to be

normal. Right subcostal soreness persisted. An interim of three weeks elapsed before another attack of pain. At this time, he was again hospitalized at an Air Force Station Hospital, and a second gallbladder roentgenologic study was done, as well as a gastro-intestinal series; both of which were reported normal. Following each attack, the patient was discharged from the hospital, with a diagnosis of epigastric pain simulating cholecystitis, cause undetermined. On April 24, 1945, about six weeks following onset of his illness, a third hospitalization was necessary because of an attack of upper abdominal pain similar to previous episodes described. At this time a rectal examination disclosed a cystic mass which filled almost the entire pelvis. On May 14, 1945, he was transferred to the AAF Regional Station Hospital, Westover Field, Mass. for definitive treatment. A history of urinary complaints disclosed that for the past two years the patient had noticed a decrease of his bladder capacity, with a slight frequency of urination and occasional nocturia. On a few occasions at night he had experienced suprapubic pain, with moderate difficulty in starting the urinary stream. At no time had he noticed gross blood in his urine.

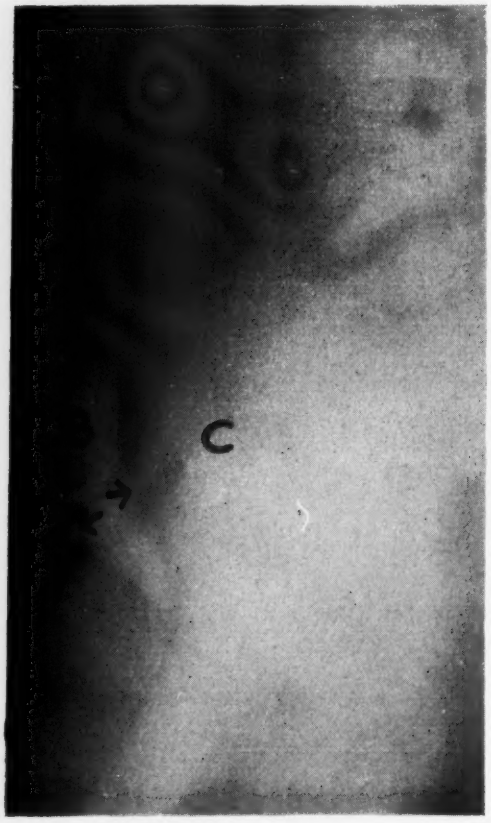

FIG. 2.—Lateral view of cystogram. (B) Tubular compression and elevation of bladder by the cyst (C).

Past History: He denied weight loss. He described a backache of ten years' duration which was not incapacitating nor did it disturb his sleep. There was no history of major illness or operation. The family history was noncontributory. In civilian life this patient was an assistant production manager in a manufacturing concern. His Army occupation was that of a chauffeur.

Physical Examination: The patient was well-developed and well-nourished. Weight about 180 pounds. There was a rather pronounced tenderness in the right subcostal margin extending down to the iliac crest. No masses were palpable. Rectal examination disclosed a nontender mass, which was estimated to be about the size of a large grapefruit. This was moderately cystic and apparently attached to the floor of the bladder, but definitely extrarectal (Fig. 1). It was ballotable to pressure in the suprapubic region. Sigmoidoscopic examination was not remarkable except for a bulging mass visualized on the anterior surface of the rectum.

Laboratory Studies: Repeated blood counts and urinalyses were normal. Blood serology was negative. Blood N.P.N., sugar, icteric index, bilirubin, total protein, cephalin flocculation, chlorides, cholestrol, calcium and phosphorus were all within normal range.

On cystoscopic examination, the bladder walls were smooth and not injected. Bladder capacity was diminished to four ounces. The trigone was markedly elevated. No diverticula or tumor masses were visualized. Both ureters were catheterized and retrograde pyelograms made. The kidneys and ureters were normal. A cystogram was

done after the cystoscope was removed and revealed the bladder to be displaced anteriorly so markedly that the cystogram had a tube-like appearance (Fig. 2).

A plain film of the abdomen, anteroposterior view, revealed a rounded elliptical mass, 10 x 11 cm., located between the lower two-thirds of the bladder and the rectal ampulla. This mass projected into the hollow of the sacrum overlying S1 and S2 and extended down to the level of the symphysis. Two linear calcific plaques, 3 cm. long, were visualized along the left border (Figs. 1 and 3).

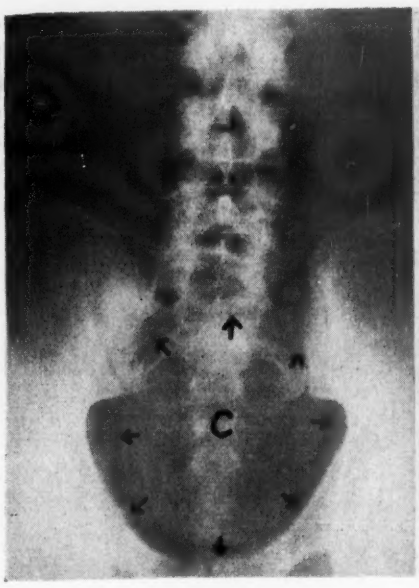

FIG. 3

FIG. 4

FIG. 3.—Plain film of abdomen showing cyst (C) outlined by arrows.
FIG. 4.—Barium enema showing displacement and compression of sigmoid colon (S) by the cyst (C).

Barium enema revealed marked compression of the rectal ampulla by the mass described above (Fig. 4).

Preoperative Diagnosis: This patient presented a large cystic pelvic mass displacing both the bladder and the sigmoid colon. Diagnoses considered preoperatively were: (1) diverticulum of the bladder; (2) enterogenous cyst; (3) dermoid cyst; and (4), remotely, an aneurysm. Diverticulum of the bladder was excluded by cystoscopic examination. Aneurysm was excluded by the physical characteristics of the mass and normal oscillometric tests of the lower extremities.

Operation: In order to facilitate anatomic orientation, ureteral catheters were introduced just prior to operation. Under continuous spinal anesthesia, a transperitoneal approach was made through a midline suprapubic incision, and an extraperitoneal mass, about the size of a large grapefruit, was exposed. The entire mass was separated down to its attachment to the anterior wall of the rectum. At this point it contained a calcific plaque. The caudal end of the cyst extended to the prostate. The left seminal vesicle was exposed but not disturbed. During the operative procedure the cyst wall ruptured and a large amount of thick mucoid material escaped. This showed no gross evidence of pyogenic infection. Frozen sections, at the time, revealed no evidence of malignancy. The entire cyst was removed except that small portion of the wall densely adherent to the anterior wall of the rectum.

FIG. 5

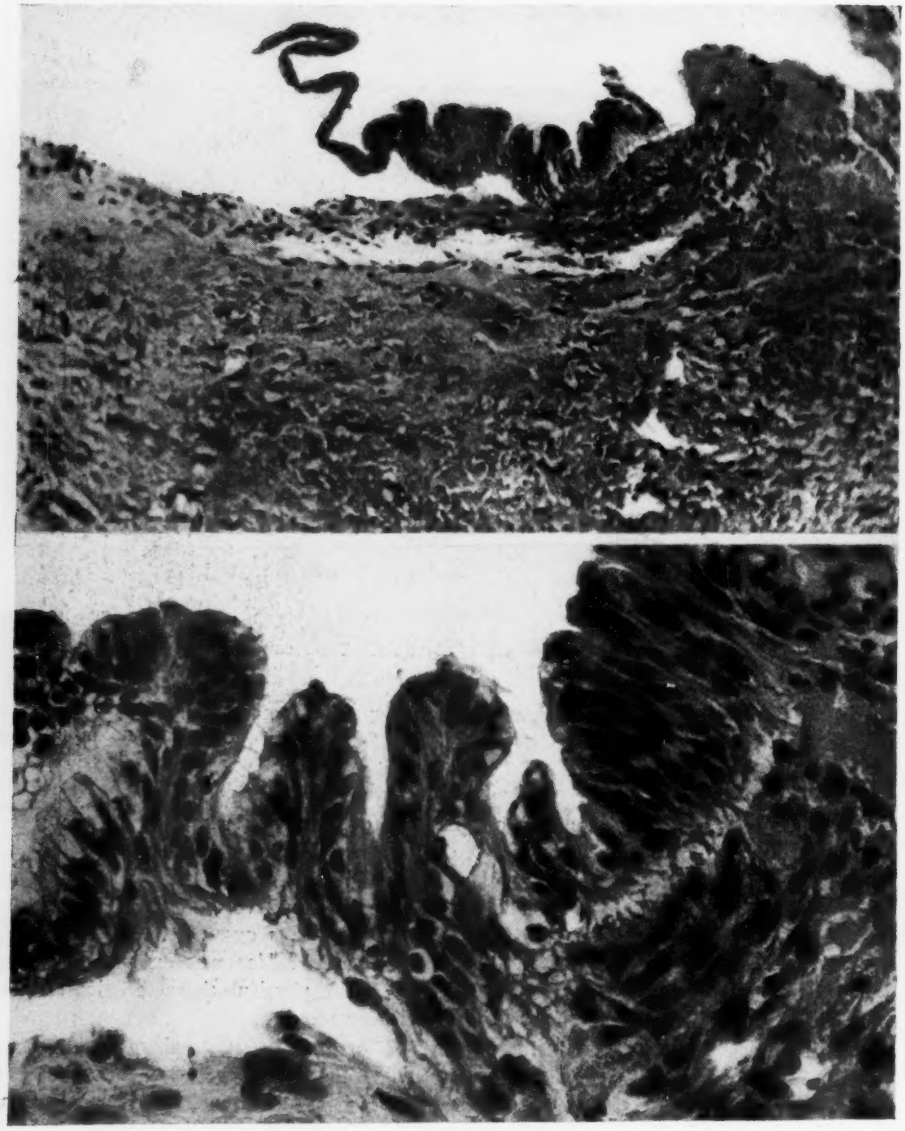

FIG. 6

FIG. 5.—Low power view of cyst wall showing remnant of epithelial lining.
FIG. 6.—High power view of tall columnar mucus-secreting epithelium.

Pathologic Report.—Gross: Specimen consists of five pieces of tissue forming the wall of a cyst, and measuring in aggregate 12 x 11 cm. The outer surface has an irregular roughened yellow-gray appearance and is covered by many thin plaques of calcium. The inner surface of the cyst is quite smooth and varies in color from grayish-white to red. No definite mucosal lining is discernible. The cyst contents consist of about 600 cc. of thick, tenacious mucoid material having the general appearance and consistency of partially coagulated egg white. The wall ranges from 1 to 8 mm. in thickness. The thicker portions of the wall on cross-section bear a striking resemblance to the wall of the intestinal tract. There are scattered areas of calcification within the cyst wall.

Miscroscopic.—Eight sections H and E. The sections show a cyst wall with considerable variation in thickness. The thinner portions of the wall are composed, for the most part, of dense collagenous and hyalinized connective tissue with scattered small foci of hemorrhage, round cell infiltration, plaques and deposits of calcium. The thicker portions of the wall show very clearly the four coats of the intestine. A few tiny shreds of epithelium are present. This is of the tall columnar, mucus-secreting type (Figs. 5 and 6). The remainder of the mucosa is quite thickened and hyalinized. The submucosa contains many fairly large collections of small lymphocytes suggestive of lymphoid follicles. There is a thick well-defined layer of smooth muscle with muscle bands running in several planes. The usual clear demarcation between the circular and longitudinal muscle bundles is not evident. The serosal coat is thickened and edematous, with many small and a few fairly large areas of hemorrhage. There are many calcific plaques and small deposits of calcium in all portions of the wall, most prominent in the submucosa and serosa. There are many small scattered collections of lymphocytes with an occasional polymorphonuclear neutrophil and eosinophil.

The histologic picture is that of intestinal wall which had undergone fibrosis, hyalinization, deposition of calcium and pressure atrophy of the epithelial lining. The cyst undoubtedly represents a developmental anomaly of the lower portion of the intestinal tract. *Pathologic Diagnosis:* Enterogenous cyst.

Postoperative Course: Convalescence was not remarkable until the 12th postoperative day. The wound had healed *per primam.* At this time, the patient had an attack of epigastric pain, nausea and vomiting with a moderate febrile reaction, similar to that experienced preoperatively. Five days following the onset of this attack, temperature rose to 103°F., and he continued with an intermittent fever for a period of eight days, at which time, the epigastric discomfort subsided and temperature returned to normal limits. The convalescence was subsequently uneventful. Four weeks following the enterogenous cystectomy a repeat gallbladder roentgenologic study was done and, at this examination, there were multiple calculi visualized within the gallbladder. It is interesting to note, at this point, that the symptoms of epigastric pain, nausea and vomiting were due unquestionably to the cholelithiasis and that the enterogenous cyst was an incidental finding and produced symptoms referable only to the urinary bladder and the low backache of which he had complained for a number of years.

A cholecystectomy was performed approximately five weeks following the initial surgery and the diagnosis of cholelithiasis confirmed.

Rectal palpation at the end of ten weeks disclosed only slight residual induration at the site of attachment of the enterogenous cyst to the anterior rectal wall. The urinary bladder symptoms had subsided and the patient returned to duty symptom free.

SUMMARY

A case of an unusually large enterogenous cyst arising from the rectum, with successful removal, is reported. The literature pertaining to enterogenous cysts, their origin, incidence and treatment, is reviewed.

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LIPOSARCOMA OF THE MESENTERY

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TUMORS OF THE MESENTERY are comparatively rare. The following case of liposarcoma is presented because it illustrates the unusually benign course which such a lesion may take. Our patient has been observed over a period of more than six years. Despite two operations, the second one for a recurrence of the original tumor, she is at present in excellent condition.

CASE REPORT.—The patient, a 56-year-old, white, unmarried, professional woman, was seen at our clinic, on June 15, 1939, at which time she complained of mild and long-standing constipation associated with belching and bloating after meals. There was no abdominal pain, and other gastro-intestinal symptoms were absent. She had noted some slight increase in the size of the abdomen despite the fact that she had been on a reducing diet and had lost twenty pounds during the past year. She had had an uneventful menopause ten years previously, and there had been no vaginal bleeding or discharge since then. The rest of the history was non-contributory.

Physical Examination.—The patient was well-developed, plump, and appeared to be in good health. The blood pressure was 136/80, the pulse 84. The head, neck, and chest were normal. The abdomen was obese and appeared distended and somewhat asymmetrical. A large, firm, somewhat nodular tumor was palpable in the abdomen. It extended upwards to half way between the umbilicus and xiphoid. This mass was freely movable and not tender. On pelvic examination, it could not be determined if the tumor was attached to the uterus. Laboratory examinations were negative. A diagnosis of fibromyoma uteri or ovarian tumor was made.

The patient entered the Johns Hopkins Hospital, under the care of Dr. Richard TeLinde. On examination there, it was believed that ascites was present and that the tumor was floating in free fluid. Pelvic examination revealed a one-finger introitus, a small conical cervix reaching high in the vagina, and a mass about three times the size of the normal uterus present anteriorly in the usual position of the uterus. A fixed tumor mass was thought to be present posteriorly on the left. Neither ovary could be palpated. It was believed that while a fibroma of the ovary might account for the picture, an ovarian carcinoma with ascites was the most likely diagnosis.

Operation.—June 30, 1939. A pelvic examination, under ether, was made preoperatively. At this time, a very small, freely movable uterus could be felt anteriorly, and no masses were present in the fornices. On palpation, a large cystic mass seemed to occupy the whole abdominal cavity. The diagnosis was consequently changed to intra-abdominal, nonpelvic tumor.

On exploration, a large cystic tumor, encapsulated in a glistening white covering, was found. This mass contained solid areas in it. It rose high in the abdomen from the gastrocolic ligament, and was closely adherent to the large and small bowel and to the greater curvature of the stomach. There was no attachment to the pelvic organs. The tumor was freed from its attachments without injury to stomach or intestines and delivered *en masse,* after which the abdomen was closed. The patient made an entirely uneventful recovery and was discharged in good condition. Histologically, the tumor was felt to be a benign fibrolipoma containing "peculiar looking giant cells" (Fig. 1).

Following her recovery the patient returned to a strenuous and responsible government position and found that she could carry her work as well as ever. She was entirely asymptomatic until the end of 1944, when she again noted some enlargement of the abdomen and slight indigestion, consisting of belching, flatus, and fulness after meals. Moderate constipation was still present but was no worse than it had been for many years. She had lost a little weight.

Physical Examination.—December 14, 1944. The patient was an obese, healthy appearing, 61-year-old, white female. Findings were negative except for the abdomen. The abdominal wall was seen to be slightly elevated in the left para-umbilical region. In this area a mass about four inches in diameter could be felt. This was smooth, nonpulsating, nonfluctuant, and slightly movable from side to side only. It was dull to percussion. The liver edge could be felt on deep inspiration. Rectal examination revealed a small, anterior, freely movable uterus. Laboratory studies were negative. A gastro-intestinal series showed that the tumor was outside the intestine and was pushing the stomach upwards and the transverse colon downwards. The diagnosis of a recurrent fibrolipoma was made.

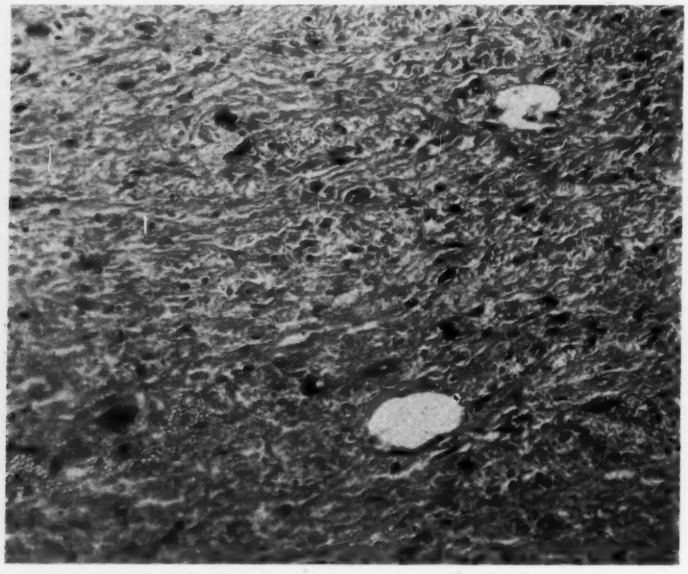

FIG. 1.—Photomicrograph of first tumor, removed June 30, 1939. Note presence of large giant cells. (x 150)

Second Operation.—January 17, 1945. A celiotomy was performed at the Garfield Memorial Hospital, Washington, D. C. by Dr. Herbert Schoenfeld. On opening the abdomen, it was found that the gastrocolic omentum contained numerous discrete tumor masses, varying from the size of a marble to that of a walnut. An encapsulated tumor, about five inches in diameter, was present in the inferior leaf of the transverse mesocolon. This was easily shelled out. Several of the small masses were released from the gastrocolic omentum and numerous thickened areas of fat were palpable throughout this omentum. Because all the tumor-bearing tissue could not be mobilized and because of local damage, the transverse colon was resected. Following this, a daughter tumor, the size of a walnut, was found under the splenic flexure of the colon and was shelled out. The abdomen was then closed. The patient had a somewhat stormy postoperative course,

became considerably distended, and did not respond well to supportive measures. A blow-out at the suture site was feared. Decompression was, therefore, performed, January 20, 1945, by means of an appendicostomy. She made an excellent response to this procedure and, February 6, 1945, 20 days postoperatively, she was discharged from the hospital in good condition except for some infection and drainage at the site of the cecostomy incision. A local sinus of the abdominal wall which formed in this area was excised in May, 1945, and following this the wound healed completely.

The patient has returned for follow-up visits, and when last seen, in November, 1945, she was back at her job and in excellent condition. She stated that her bowels "had never been so good."

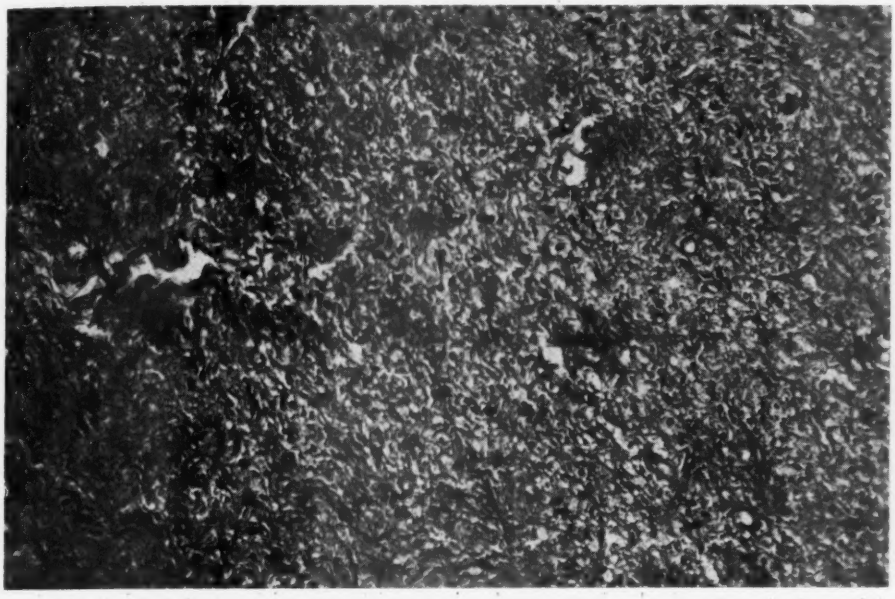

FIG. 2.—Photomicrograph of second tumor, removed January 17, 1945. A few small giant cells are present. The stroma is much more cellular but the majority of cells are well differentiated and benign in appearance. (x 150)

The second tumor (Fig. 2) and sections of the first growth were studied by Dr. Janvier W. Lindsay, pathologist of the Garfield Memorial Hospital, and by Col. J. E. Ash, and his associates, of the Army Institute of Pathology. It was their opinion that all slides, including those of the first operation, were consistent with a diagnosis of low grade liposarcoma.

DISCUSSION.—The above case presents a number of interesting aspects. Symptomatically, these tumors have been divided into two groups by Hart.[1] In the first group are the "silent" growths which are discovered accidentally on physical examination. In the second, are those tumors giving abdominal symptoms which vary from those of mild indigestion, distention, constipation, *etc.*, to those of the "acute surgical abdomen." The more dramatic latter picture may be the consequence of intestinal obstruction resulting from volvulus or intussusception, or from accidents, such as hemorrhage into the tumor or peritoneal cavity, rupture of a cyst, with or without peritonitis, or

infection within a cystic tumor itself. Obviously, tumors in Group I may progress to Group II. Our patient would fall into the second group, but the symptoms were indeed so minimal that the physician who first saw her expected to find a negative abdomen until he proceeded to the physical examination.

Diagnostically, these tumors present a considerable problem. Their true nature is seldom recognized before operation.[7, 8] In women, they are often mistaken for ovarian or uterine growths, as was the case with our patient. In cases where the tumor has been recognized to be nonpelvic in origin the diagnosis of retroperitoneal sarcoma, tumor of the kidney, hydatid cyst, tuberculoma, *etc.*, has been made. When the picture is complicated by an acute abdominal crisis recognition is much more difficult, and patients have gone to surgery with the preoperative diagnosis of intestinal obstruction, acute appendicitis, appendiceal abscess, acute cholecystitis, ruptured ulcer, *etc.* One of the chief stumbling blocks to preoperative diagnosis lies in the fact that the condition is sufficiently rare so that it is not likely to be considered. However, an intra-abdominal tumor lying outside the pelvis, solid or cystic, movable from side to side, and shown roentgenographically to be outside the G. I. and G. U. tracts should make one suspect this diagnosis.[2]

Surgical technics in the management of solid mesenteric tumors divide themselves into two types. Local removal may be feasible, as was the case at our patient's first operation, or a partial resection of the intestine may have to be performed for various technical reasons, such as existed at her second operation. The operative mortality is variable. Mills[4] states that it is in the neighborhood of 20 per cent, without giving the source of this estimate. In Hart's[1] collected series of explored patients, which was 66 in number, 7 patients, or 10 per cent, died after simple celiotomy, with biopsy, 12 patients, or 18 per cent, died after enucleation, with or without resection, and 47 patients, or 72 per cent, recovered after a major surgical procedure. The mortality rate is unfavorably influenced by the presence of an acute surgical emergency; by the necessity for extensive resection; and by the presence of a far-advanced inoperable condition.

Pathologically, mesenteric tumors have been classified into the solid and the cystic. Histologically, they are primarily divided into the benign and the malignant, and may then be subdivided into many more precise categories. Sarcomata are the most frequent among the malignant tumors. It is not uncommon to have a variation of opinion among pathologists as to the nature of the tumor, and disagreement may exist on the presence or absence of malignancy.[1] Time may help to make the differential point, as it did for us. The prognosis, discounting operative mortality, depends, of course, on the histopathology found. Rankin and Major,[6] and Judd and Crisp,[3] all of the Mayo Clinic, feel that the outlook in malignant tumors is unfavorable. However, review of the literature does not bear out such a general conclusion, and other authors do not agree with it.[1, 4, 5] The degree of malignancy of mesenteric tumors appears to be very wide. While there are reports of

certain cases in which such far-advanced metastases were found that removal was out of the question, there is a considerable number of cases in which the malignancy was of a low grade and the outlook for prolonged survival appeared to be excellent. That a sarcoma may be consistent with a long, productive survival is well illustrated by this case. We were fortunate enough to observe our patient over an unusually long period of time. Were a similar opportunity given to others, they might report the same tale.

SUMMARY

A case of low grade liposarcoma of the mesentery is presented. The patient, now a 61-year-old, white female, has undergone two major surgical procedures for this condition, and is at present in excellent health. Some of the interesting features of this case and of these tumors in general are discussed.

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SPLENECTOMY

REMOVAL OF A SPLEEN WEIGHING 5,450 GRAMS

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SPLENECTOMY is a well-standardized operative procedure, and the results have been very satisfactory if done when the proper indications exist.

The generally recognized indications for removal of the spleen are: 1. Rupture of the spleen. 2. Early congestive splenomegaly (Banti's syndrome). 3. Idiopathic thrombocytopenic purpura. 4. Familial hemolytic icterus. 5. In some cases of known (*e.g.*, chronic malaria, Gaucher's disease) or idiopathic splenomegaly, which, because of the size of the spleen, produces mechanical pressure effects upon neighboring structures (*e.g.*, stomach; diaphragm). The case herein reported belongs in the last group of cases. The enlarged spleen was believed to be the result of a chronic malarial infection.

Cirrhosis of the liver with or without an associated ascites is considered to be a contraindication for splenectomy. Because of the compromise of hepatic function the prognosis under conservative therapy is equal to that following operation, without the added risks of the latter. Other contraindications for surgery are advanced chronic debilitating diseases involving the pulmonary, cardiovascular and renal systems.

In the determination of operability, the size of the spleen *per se* is not a contraindication. The same applies to the associated anemia when present. This will be commented upon later. Each case presents its own individual problems.

In the present case, the spleen upon removal weighed 5,450 Gm.† (12 pounds), and measured 32 cm. x 25 cm. x 10.6 cm.‡ in size. To visualize more clearly the huge size of the spleen, its weight was compared to that of the body weight of the patient and found to be the equivalent of one-eighth of the latter. Following the removal of such a large space-occupying viscus, signs and symptoms referable to a sudden change in intra-abdominal pressure relations might have been expected to occur. None were observed.

In the removal of a spleen of this proportion there are certain technical points which may be considered. A longitudinal left paramedian incision is preferred with the operator standing to the left of the patient. The larger the spleen and the lower it extends towards the pelvis, the less suitable is

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† Normal: 100–250 Gm. (Gray's Anatomy).

‡ Normal: 12 cm. x 7 cm. x 3.4 cm. (Gray's Anatomy).

any other type of incision. A transverse-T extension of the incision is not considered necessary. In the mobilization of the spleen, care must be exercised to prevent tears in the parenchyma. These tears are easily produced and may result in troublesome hemorrhage. It has been the experience of one of the authors (J.L.M.) that the ease with which mobilization and deliverance of the spleen is accomplished varies in a direct ratio to its size.

A consideration of prime technical importance is the anatomic relationship between the tail of the pancreas, the greater curvature of the stomach, and the pedicle of the spleen. This relationship is constant, and its surgical importance cannot be overemphasized. A lack of knowledge pertaining to it may result in unrecognized damage to the pancreas and/or the stomach during the application of clamps to the pedicle of the spleen.

In the large spleen the exposure of the pedicle does not present the technical difficulties inherent in the small one. In the former, division of the posterior layer of the lienorenal ligament is more easily accomplished, permitting a further mobilization of the spleen. Following the division of this ligament the recognition of the anatomic relation between the pancreas and the splenic pedicle is mandatory. These structures may be separated without difficulty by blunt tissue dissection, isolating the lienal vessels posteriorly. The isolation of the spleen and its pedicle anteriorly is completed by dividing the anterior layer of the gastrolienal ligament, and clamping and ligating the contained vasa brevia. This permits retraction of the greater curvature of the stomach and completes the exposure of the splenic pedicle.

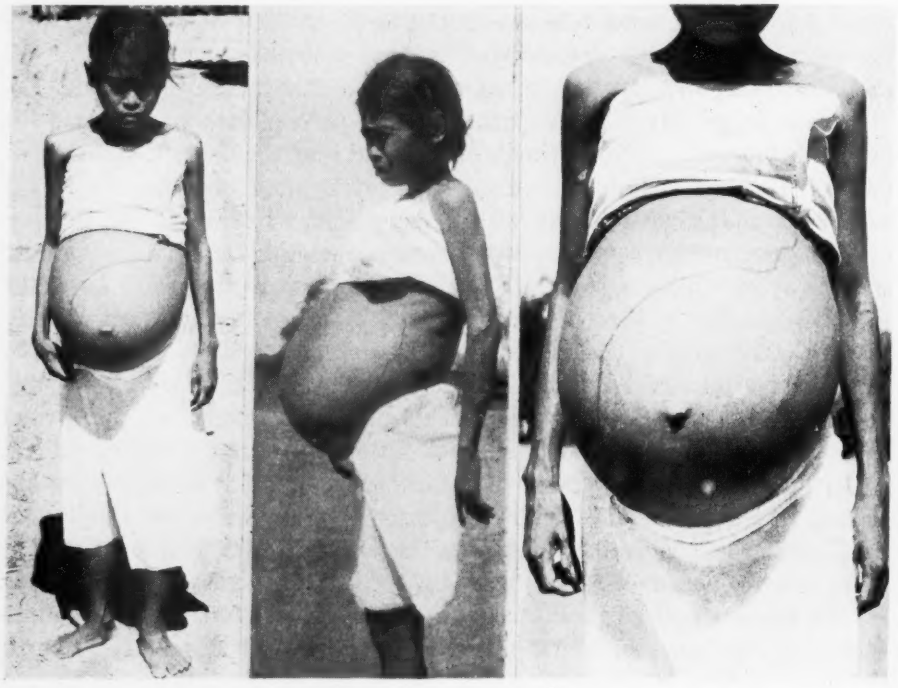
In the surgical management of the pedicle we prefer the clamp method because of the technical difficulties pursuant to the isolation and individual ligation of the huge, dilated, thin-walled vessels. The pedicle is serially clamped (triple clamp method) and divided between the two distal clamps. Double ligation (silk) of the proximal stump is performed. A reperitonization of the pedicle bed is not necessary. The wound closure is in layers without drainage.

In the case presented, a selective ligation and division of the lienal artery, followed by the intravenous administration of epinephrine had been contemplated for the purpose of contracting the spleen and autotransfusing the patient. This was not done because of the potential danger of transferring an excess of hemolyzed red blood cells into the systemic circulation. The use of fresh whole blood during and immediately following the operation was considered preferable.

In the case herein reported the spleen is one of the largest to have been successfully removed, with the recovery of the patient. In the case reported by Pick[1] the spleen weighed 8,100 Gm. Mandelbaum,[2] and his associates, reported the removal of a spleen which measured 38 cm. x 24 cm. x 13 cm. and weighed 6,822 Gm. The spleen recorded by Horsley weighed 5,890 Gm. In each of the reference cases the causative factor for the enlargement of the spleen was Gaucher's disease.

Case Report.—The patient, a 27-year-old Filipino female, was admitted to the hospital, January 15, 1945, with the history of a progressive enlargement of the abdomen during the past seven years. In the last year, a more rapid increase in the size of the abdomen had occurred, with an increasing dyspnea, weakness, anorexia and loss of weight. Due to the multiplicity of the symptoms produced she entered the hospital for treatment.

A review of her past history showed that she had not menstruated for two years. However, a vicarious menstruation (epistaxis) of one day's duration had occurred at regular intervals each month, the time corresponding to the expected date of her normal menstruation. She had had repeated attacks of malaria, "too many times to count."



A B C

FIG. 1.—(A) and (B). Distant photographs to demonstrate the size of the abdomen to relation to the body-size of the patient.

(C). Close-up view showing the outline of the spleen in relation to the anterior abdominal wall.

There was a progressive weight loss, the amount unknown. She weighed 96 pounds on admission.

Physical Examination.—The patient was a fairly well-developed but poorly nourished female who appeared chronically ill. The cervical veins were prominently distended even in the upright position. There was a marked pallor of the exposed mucous membranes. The respirations were rapid and shallow, with an associated periodic congestive type of cough. Dental caries was severe. Examination of the lungs revealed moist râles in both bases, more marked on the left. The heart was normal.

The abdomen was markedly protuberant and comparable in size to that of a full-term gestation. The superficial veins of the abdominal wall were slightly dilated. On palpation, the abdomen was soft and not tender. The spleen was readily palpable. It

occupied the greater part of the abdomen and extended downward into the pelvis. The notch and anterior border were easily outlined, the latter extending into the right lower quadrant. The inferior border could not be defined.

A blood count on the day of admission showed 1,630,000 red blood cells; 3,600 white blood cells, and a normal differential count. Blood smears for the malarial parasite were repeatedly negative inclusive of serial smears taken following the intravenous administration of epinephrine (0.5 cc.). Roentgenograms of the chest were negative. A plain film of the abdomen demonstrated a diffuse and dense shadow which extended throughout the whole of the left side of the abdomen into the right lower quadrant.

FIG. 2

FIG. 3-A

FIG. 3-B

FIG. 2.—The spleen has been mobilized and manually retracted toward the midline. The posterior layer of the lienorenal ligament has been divided and the tail of the pancreas separated from the posterior aspect of the splenic pedicle. This permits the complete exposure of the pedicle posteriorly. (See text)

FIG. 3.—(A). View of the outer surface of the spleen following its removal. The spleen is held in a manner to simulate its position within the abdomen. Note the apical scar.

(B). The under surface of the spleen showing the dilated veins of the pedicle.

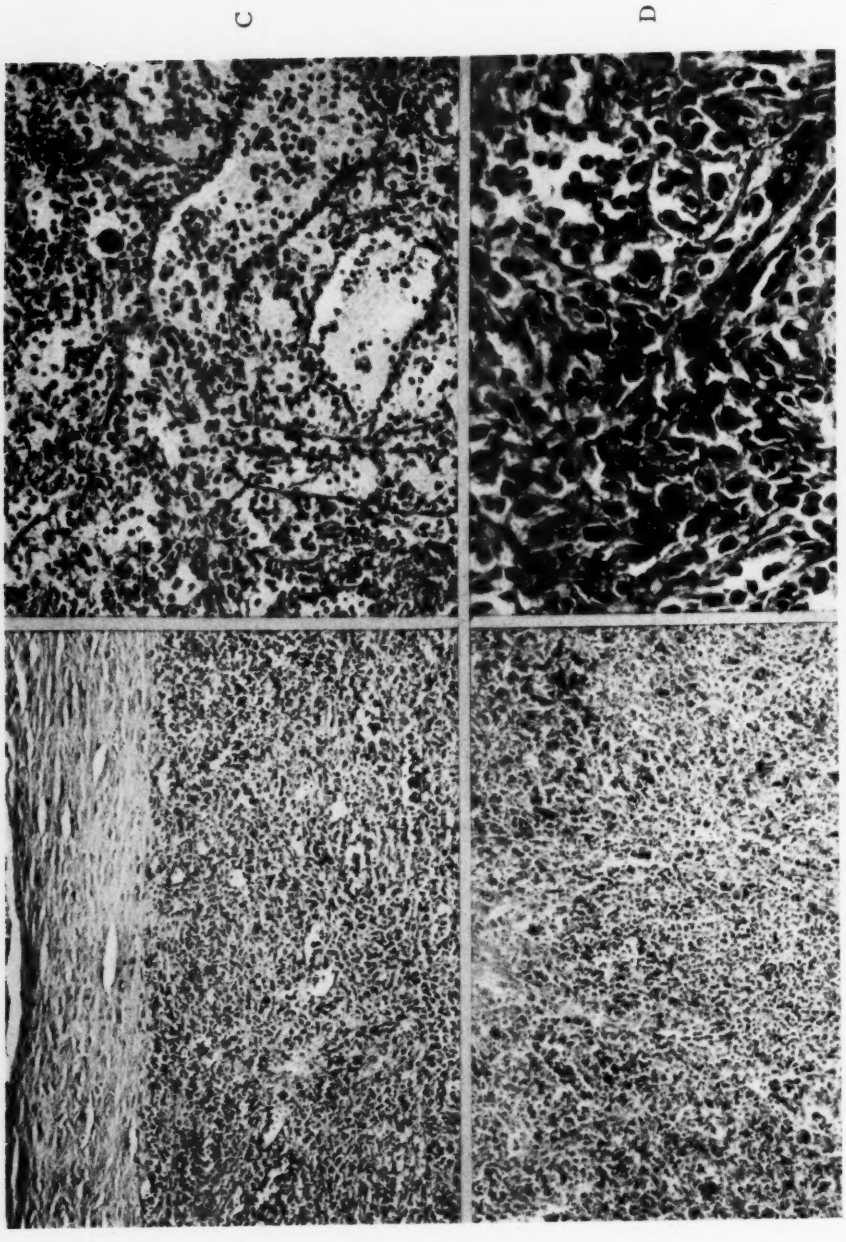


FIG. 4.—(A). (A.M.M. Neg. No. 89746) Thickened capsule and dilated capsular vein.
(B). (A.M.M. Neg. No. 89744) Small follicle and congested pulp.
(C). (A.M.M. Neg. No. 89747) Marked dilatation of sinusoids.
(D). (A.M.M. Neg. No. 89745) Few parasitized erythrocytes and phagocytized malarial pigment in single granules and agglutinated masses.

General supportive and symptomatic measures were given. This included a high caloric diet rich in vitamins, iron and vitamin therapy, and strict oral hygiene. The latter embodied the removal of carious teeth. Five hundred cubic centimeters of whole citrated ("stored" or "bank") blood was given on January 16, 1945, and repeated daily for the succeeding four days. The red blood cell count at this time was 2,120,000, an increase of only 490,000 despite the administration of 2,500 cc. of blood. Daily blood transfusions were restarted on the 23rd of January. Two days later the amount was increased to 1,000 cc., and this was administered every other day for the succeeding six days. A total of 8,000 cc. of blood was administered over a period of 16 days, with an increase of only 700,000 in the red blood cell value. (R.B.C. 2,330,000; W.B.C. 4,850.) Despite this lack of a satisfactory increase in the red blood cells a marked improvement in the general condition of the patient had occurred. She was ambulatory daily and her appetite was very much improved.

FIG. 5.—Photograph of the patient 13 days following the operation. The incisional scar may be faintly visible.

The operation, originally scheduled for February 2, 1945, was cancelled because of the development of an hyperpyrexia (104° F.). On questioning, it was learned that she had taken her atabrine tablets very irregularly. Active atabrine therapy was immediately started and was followed by a return of the temperature to normal within 48 hours. Despite this she did not appear well and complained of weakness. Her appetite was poor. Examination of the abdomen revealed it to be tense, diffusely tender, and more protuberant than previously noted. Ascites was thought to be present. The liver edge was palpable four finger's breadth below the right costal margin. The liver was not palpable on admission to the hospital. During the succeeding five days a gradual

but progressive improvement occurred. A blood transfusion of 500 cc. was given on two occasions during this period, making a total volume of 9,000 cc. of blood administered prior to operation.

Operation.—February 8, 1945: Under closed ether-oxygen anesthesia, a celiotomy was performed through an upper left paramedian incision. There was no free peritoneal fluid and the liver, though enlarged, appeared normal. The spleen was mobilized without difficulty and removed. The veins of the splenic pedicle were enormously dilated, the largest measuring two centimeters in diameter. The wound was closed in layers (silk) without drainage. Five hundred cubic centimeters of fresh whole citrated blood was given during the operation and another 500 cc. upon return to the ward. The spleen weighed 5,450 Gm. (12 pounds), and measured 35 cm. x 25 cm. x 10.6 cm. in size.

Postoperative Course.—This was uneventful. The highest temperature recorded was 101.4° F., on the day following operation. Subsequent to the fifth day the temperature maintained a normal level. Blood transfusions (500 cc.) of fresh whole citrated blood were given on the first and third postoperative days. A normal water and salt balance was maintained during the early postoperative period by the parenteral administration of saline and glucose solutions. Sutures were removed on the fifth day. Wound healing was *per primam.* She was allowed out of bed on the tenth day, and discharged from the hospital on the 17th day after operation. Examination at this time showed the liver edge still to be palpable three fingers' breadth below the right costal margin. There was a diminution in the muscle tonus of the abdominal wall, with a mild protrusion of the abdominal viscera. She had no subjective complaints. The objective improvement was marked. A blood count made on the day of discharge revealed 4,110,000 red blood cells; and 8,500 white blood cells, with a normal differential count.

Pathologic Examination.—Spleen: (A.M.M. Accession 180365). "The splenic capsule is thickened and hyalinized and there are several torn vascularized fibrous adhesions. The follicles throughout all sections are sparse. Those that are seen are small and composed of small lymphocytes. There is generalized dilatation of the sinusoids. Many of these contain red blood cells and an occasional pigmented macrophage. Others are widely distended and empty. In places the pulp is crowded with phagocytic cells, some contain erythrocytes, others contain single, dark brown, pigment granules. In the region of the greatest dilatation of the sinusoids the Billroth cords are narrow and fibrotic and masses of agglutinated pigment are present. The lining cells of the sinusoids do not contain pigment. Scattered throughout the pulp a small number of red blood cells contain single pigment granules, which on Giemsa stains appear to be malarial plasmodia."

COMMENT.—The lack of an adequate response to the number of blood transfusions given is noteworthy. Eighteen transfusions (9,000 cc.) of whole citrated blood were administered during the three-week period prior to operation. There was an increase in the red blood cell value from 1,630,000 to 3,930,000, an increment of 2.3 million.

The reason for the comparatively meager and slow rise in the number of red blood cells in relation to the number of blood transfusions given, may be related to two factors: (1) The destructive hemolytic action of the spleen; and (2) the use of "stored" or "bank" blood. In reference to the latter, it has been our observation that the clinical response of the patient and the rise in the number of red blood cells do not parallel that obtained when fresh whole blood is used.

The liver was not palpable on admission, a fact which was confirmed by two other examiners. One week prior to operation examination showed the abdomen to be tense and more protuberant. Tenderness was diffuse. The liver edge was palpable four fingers' breadth below the right costal margin. Ascites was believed to be present, but was not confirmed at operation. These findings were associated with abdominal discomfort and an increasing respiratory distress. The changes produced were believed to be the result of a congestion of the portal system secondary to the large volume of blood given.

We are of the opinion that in the preoperative preparation of cases of splenomegaly, blood transfusions should be given in moderation. In the attempt to correct the anemia present enthusiasm may overrule better judgment, particularly when the anemia is refractive to treatment. The clinical response of the patient is a better guide to govern the amount of blood to be administered. If the general condition of the patient is satisfactory the anemia *per se* should not be a contraindication to splenectomy. The elimination of the hemolytic action of the spleen by its removal, and the administration of fresh blood during the operation and in the early postoperative period are more effective in correcting the anemia than the use of large amounts of blood preoperatively. These statements receive confirmation upon review of the case presented.

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SURGICAL TREATMENT FOR DYSPHAGIA LUSORIA

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DYSPHAGIA LUSORIA has long been recognized as impairment of swallowing which occurs when a right subclavian artery arises abnormally from the left side of the aortic arch and then passes behind or in front of the esophagus and thereby compresses the esophageal tube. As early as 1794, Bayford[1] nicely described such an anatomic malformation and the clinical picture which it produced. An anomalous subclavian artery can exist without making itself manifest; it may be incidentally discovered at a postmortem examination. In other individuals it produces symptoms which are mild, and of little consequence. In occasional patients the disturbance in swallowing may be severe enough to interfere seriously with the individual's health or nutrition. Dysphagia is most apt to appear or to be aggravated (1) when the artery is taut and stretches across the esophagus like a bow-string; (2) when the vessel becomes sclerotic and less elastic in the latter part of life; or (3) when there is aneurysmal dilatation of the artery. The detection of the anomaly by roentgenological studies has been recently discussed by Copleman.[2] So far as I am aware, the following case is the first in which surgical division of such an anomalous vessel has been attempted.

Case Report.—J. R., a four-month-old baby, was referred to the hospital, November 14, 1945, by Dr. Joseph F. Gibbons, because of difficulty in feeding. At about four weeks of age it was first noticed that the child had discomfort or pain while nursing. During the act of deglutition, a little of the milk would be swallowed without hesitation, but the baby would then become fretful or would cry; following this he would either refuse to take more of the feeding, or would take it only under protest. Sometimes, six or eight ounces of the mixture would be ingested without much trouble, but on most occasions there was obviously something wrong after an ounce or two had been swallowed, and the child would "stiffen up with pain." There was occasional regurgitation of uncurdled milk, but there was no projectile vomiting. Several changes of formula were made without apparent benefit. At about four months of age, cereal was offered; this was taken eagerly in small amounts, but after it the baby would always refuse milk for several hours. In spite of these difficulties the weight-gain had been satisfactory, yet it was obvious that this state of affairs had depended upon an intelligent and attentive mother who had discovered that an adequate amount of milk mixture could be given to the baby by offering 15 to 20 small feedings through the day.

Physical Examination: The child appeared to be healthy. He weighed 16 pounds, 2 ounces. There were no important variations from the normal in the abdomen or chest. The baby was alert, and there was no reason to suspect central nervous system disease or birth injury.

Course: Roentgenologic examination in the lateral projection, after ingestion of a thin barium mixture, showed an indentation of the posterior wall of the esophagus at the level of the third thoracic vertebra. When viewed anteroposteriorly, this filling de-

fect lay in an oblique direction, and suggested that there was an elongated, narrow structure which ran upward and to the right between the vertebral column and the esophagus. Some of the films showed air in the entire trachea; this was not displaced, distorted, or compressed in any way. The roentgenologic findings were interpreted by Dr. Edward Neuhauser as representing an anomalous right subclavian artery, which arose from the left side of the aortic arch and then ran upward and to the right behind the esophagus so that this tube was compressed along its posterior wall.

The child was observed on the ward for 12 days. On some occasions the baby would take an entire feeding of six or eight ounces in a reasonably satisfactory manner.

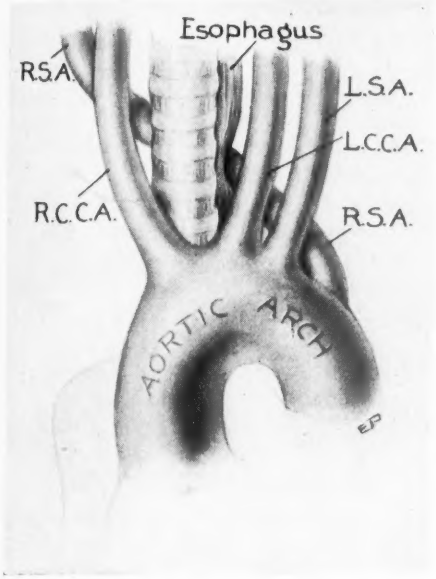

FIG. 1.—Drawing of anatomic arrangement found at operation. The anomalous right subclavian artery compresses the posterior wall of the esophagus. L. C. C. A.—Left common carotid artery. L. S. A.—Left subclavian artery. R. C. C. A.—Right common carotid artery. R. S. A.—Right subclavian artery.

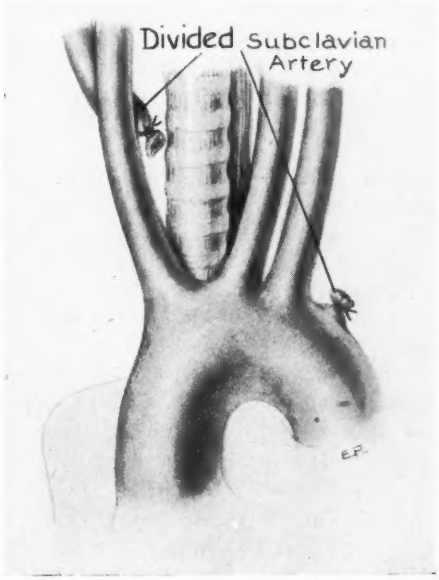

FIG. 2.—Surgical procedure. Esophageal compression has been relieved by dividing the right subclavian artery.

At other times, he would swallow only an ounce or two, would cry, and then refuse to take more. Through the first week, there was a weight loss of 14 ounces, but during the second week the child was urged much more during feedings and the weight rose again to the admission figure. From the history and hospital course it was obvious that the child's life was not endangered by the esophageal obstruction, and, indeed, the baby could be kept in a satisfactory state of nutrition with the existing intrathoracic abnormality. However, it was also clear that the difficulties in feeding were considerable, and it was reasonable to believe that the symptoms could be alleviated if the anomalous vessel were divided and the esophagus freed.

Operation.—November 26, 1945: Under cyclopropane anesthesia, with a tightly fitting face mask, and without an intratracheal catheter, anterolateral approach was made through the left side of the chest, entering the pleural cavity through the third interspace. The third and second costal cartilages were divided. This gave an excellent exposure of the mediastinum. The aortic arch lay in a normal position. The thymus

was partially dissected away and exposure was gained toward the patient's right so that the entire arch and its various branches could be adequately viewed (Fig. 1). The right subclavian artery arose in an anomalous fashion from the posterior aspect of the left side of the aortic arch and then coursed upward and to the right behind the esophagus, the posterior wall of which was indented. Between this anomalous artery and the vertebral column the thoracic duct was clearly visible and could be left undisturbed during the subsequent dissection. The right subclavian artery was extensively liberated from its bed and was then doubly ligated and divided near the aortic arch. The distal portion of the artery was permitted to retract to the patient's right and beyond the esophagus (Fig. 2). The lung was completely reëxpanded and the chest appropriately closed. I did not hesitate in dividing the first portion of the subclavian artery, since it was assumed that there would be branches from the second and third parts of the vessel for maintenance of an adequate circulation in the right arm.

Postoperative Observations: Following operation the baby had an extremely satisfactory convalescence. For the first 36 hours oral fluid was given in limited amounts, but after this a full formula was used. Feedings were offered on a four-hourly schedule, and were taken without hesitation. The wound healed *per primam*. At the completion of operation no radial pulsation could be detected, but a faint beat could be felt in the right axillary artery. At the time of hospital discharge, frequent but irregular pulsations could be felt at the wrist. Accurate skin temperature readings were not made, but at all times the right hand and arm felt as warm as the left. The baby was discharged from the hospital in a very satisfactory state on the tenth postoperative day.

When last seen, January 7, 1946, the baby had had no trouble in swallowing, and had gained to 18 pounds, 6 ounces. Barium examination of the esophagus showed it to be normal. The right hand and arm were warm, moved normally, and were pink. The right radial pulse could not be accurately counted, but frequent beats could be felt.

The favorable outcome in this case certainly suggests that dysphagia lusoria can be treated by surgical means. An anomalous subclavian artery does not always produce symptoms, but when it does so, any pressure on the esophagus can be abolished by the procedure which is here described. The intrathoracic part of the subclavian artery can be divided with impunity because the second and third portions of the vessel have collateral channels which are sufficient to maintain a satisfactory flow of blood to the arm.

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PULMONARY ACTINOMYCOSIS

ITS TREATMENT BY PULMONARY RESECTION IN CONJUNCTION WITH CHEMOTHERAPY

REPORT OF TWO CASES

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PATIENTS with pulmonary actinomycosis present a challenge to therapeutic measures. In a series of 1,330 patients with actinomycosis, collected by Cope,[1] the thorax was involved in 15 per cent. The results of treatment employing such time-honored measures as potassium iodide, thymol, vaccines, and roentgen rays, have, in general, proved unsatisfactory. With the advent of the sulfonamides, encouraging results were reported[2-12] in a number of patients having cervicofacial, thoracic, and abdominal actinomycosis, particularly when sulfathiazol and sulfadiazine were employed. However, many patients were refractory, or had only temporary improvement under this form of therapy.

Because of the reported[13] bacteriostatic effect of penicillin on actinomycosis, this agent has been employed clinically with encouraging results.[14, 15, 16] Although sulfonamides and penicillin have been of value in the treatment of actinomycosis, many authors conclude that the most successful results will be obtained when chemotherapy is used in conjunction with surgical measures.

Pulmonary actinomycosis is probably secondary to aspiration of the infected material from the mouth,[17, 18] for these organisms are normally harbored about carious teeth and tonsillar crypts. A pneumonic process results, characterized by suppuration and fibrosis. Burrowing of one abscess to another is commonly seen. The infection usually involves the pleura and eventually results in multiple thoracic sinuses. The disease may be either unilateral or bilateral. Microscopically, a highly vascular granulation tissue is found characterized by areas of suppuration and fibrosis. Giant cells are frequently seen. A diagnosis can be established only by finding the actinomycotic granules.

The clinical course is that of a debilitating disease. The patients may give a long history of pulmonary suppuration when first seen. The disease is characterized by periods of remission and exacerbation. During the periods of remission, there is a low-grade fever, a productive cough, expectoration that may be bloody, and pleural pain. There is a progressive loss of weight and strength. In the two patients to be presented, periods of exacerbation occurred every six to ten weeks, associated with evidence of increased toxicity; a spiking fever to 104°F. daily, an increase in sputum, pleural pain and evidence of extension of the disease, roentgenologically. The clinical diagnosis rests upon identifying the organism, preferably from exudate obtained bronchoscopically, to prevent contamination, otherwise from

mouth content. Nothing specific is noted roentgenologically. The roentgenograms show extensive areas of suppuration and pneumonitis. In the later stages evidence of osteomyelitis involving the ribs may be seen. It must be differentiated clinically from tuberculosis, other fungous infections, and pyogenic suppurative disease.

The case histories to be presented are reported because of their interest from the standpoint of therapy. Both patients suffered from the progressive pulmonary suppuration for more than a year. The onset in one was insidious, while in the other it followed extraction of teeth. The disease appeared progressive and refractory to more than adequate treatment with sulfadiazine and penicillin, used both alone and in combination, almost constantly over a period of a year. At one time, in addition to the above, potassium iodide or thymol was also employed. Except for decreasing the evidence of toxicity during the periods of exacerbation, these chemotherapeutic measures appeared to be of no permanent value. Because of the failure to improve after this period of time, pulmonary resection was resorted to, with apparent success. In the first patient, the diagnosis was suspected but not proved until microscopic verification of the pathologic sections postoperatively, and identification of the organism by culture. Because of the excellent results obtained in the first patient by pulmonary resection, operation in the second patient was advised after he had failed to improve on chemotherapy.

As in tuberculosis, the disease is usually more extensive than is noted roentgenologically. If, in patients with unilateral pulmonary actinomycosis unrelieved by chemotherapeutic measures, pulmonary resection is resorted to, total pneumonectomy should probably be undertaken rather than partial resection, if there is any question as to the extent of the disease. The pulmonary involvement in both of the patients to be presented was found to be considerably more extensive at the time of operation than was apparent preoperatively. The interlobar fissures and pleural surfaces were completely obliterated by pleural involvement, necessitating dissection in the extrapleural plane in several places. Burrowing of the abscesses across the longitudinal fissure was present. In the first patient, a left pneumonectomy was performed, with success. In the second patient, a right upper lobe lobectomy and segmental resection of the dorsal segment of the right lower lobe was undertaken. In this case there was an immediate recurrence of the disease in the remaining portion of the lower lobe, requiring removal of this and the middle lobe. With the extensive pleural adhesions, the likelihood of entering abscesses during the dissection and further contaminating the pleura is great. With the lung removed, a high concentration of penicillin and sulfadiazine can be maintained in the pleural space to combat this contamination, which would not be possible following partial pulmonary resection because of the desire for early reëxpansion of the residual lung tissue and obliteration of the pleural space.

CASE HISTORIES

Case 1.—The patient, a 19-year-old white male, developed a "chest cold" in December, 1943, characterized by bloody sputum, a temperature elevation to 101°F., and pain in his left chest. Roentgenograms showed evidence of pneumonitis lateral to the left hilus. The white blood count at that time was 7,200. By January 15, 1945, the cough was productive of three ounces of bloody sputum daily. Cavitation was noted roentgenologically at the previous site of pneumonitis (Fig. 1A). All bacteriologic studies for tuberculosis were negative. The tuberculin test was positive; and the coccidiodin skin test was negative. Microscopic examination of the sputum showed *hemolytic Streptococci, Staphylococcus aureus, Streptococcus viridans,* and *micro-catarrhalis.* The clinical course was characterized by remissions and relapses, with increasing debility. An increase in toxicity, cough and sputum was noted May 1, 1944. There was also an increase in the pneumonitis in the lower lung field roentgenologically. The temperature ranged from 102° to 104°F. daily. The sedimentation rate was 56 millimeters per hour. Sulfadiazine was given between May 10, 1944 and May 24, 1944; with a blood level ranging between 13 and 15 milligrams per cent. No apparent improvement was noted, so the sulfadiazine was discontinued and intramuscular penicillin was begun (a dosage of 30,000 units every three hours). This was continued for five weeks for a total dosage of 8,500,000 units. During this period of time there was considerable symptomatic improvement — the temperature became normal, and the appetite and weight increased. The pneumonitis and suppuration, as demonstrated by roentgenograms, showed some extension in spite of the symptomatic improvement. The sedimentation rate decreased to 11 millimeters in an hour. This remission lasted until August 1, 1944, when there was a recurrence of symptoms. The temperature ranged between 102° to 104°F. The sedimentation rate increased to 54 millimeters per hour. Sulfadiazine was again given for two weeks, with the blood level being maintained at 11 milligrams per cent. The white blood count varied between 13,000 and 18,000. Only the usual organisms were found on culture. Fungous studies were not made. A similar episode was noted again in September. A third course of sulfadiazine was given between September 23, 1944 and October 23, 1944. At this time, because of failure to improve, and because the disease was progressing clinically and roentgenologically (Fig. 1B), in spite of repeated adequate courses of chemotherapy, the patient was transferred to Kennedy General Hospital for further treatment.

He had lost 30 pounds in weight. All laboratory procedures were repeated, with similar findings. Bronchoscopic examination was performed November 25, 1944. Considerable purulent, foul smelling exudate was noted coming from both the upper and lower lobe bronchial orifices. Fungous infection was suspected from the clinical course, and cultures for fungi were planted. During the next three months there were two more severe exacerbations. Upon one occasion the white blood count increased to 38,000. Sulfadiazine and penicillin were given, both alone and in combination in adequate doses, almost continually. They appeared most effective when used in combination. The total dosage of penicillin during this period was 5,940,000 units. In spite of all therapeutic measures, this patient continued to fail. The cough became almost constant, and was productive of over four ounces of bloody sputum daily. Roentgenologically, the suppurative process appeared to involve the lower two-thirds of the left lung (Fig. 1C). On February 3, 1945, bronchoscopic examination was repeated, with findings similar to those previously noted. Because of the progression of the disease and its failure to respond to chemotherapy, a pneumonectomy was performed February 12, 1945.

At operation, the inflammatory process appeared to involve the entire lung except for the apex. The longitudinal fissure was not distinguishable because of the infection. The pleural surfaces were edematous in many places, and in others so united by inflammation that separation was unusually difficult, necessitating, in several regions, the

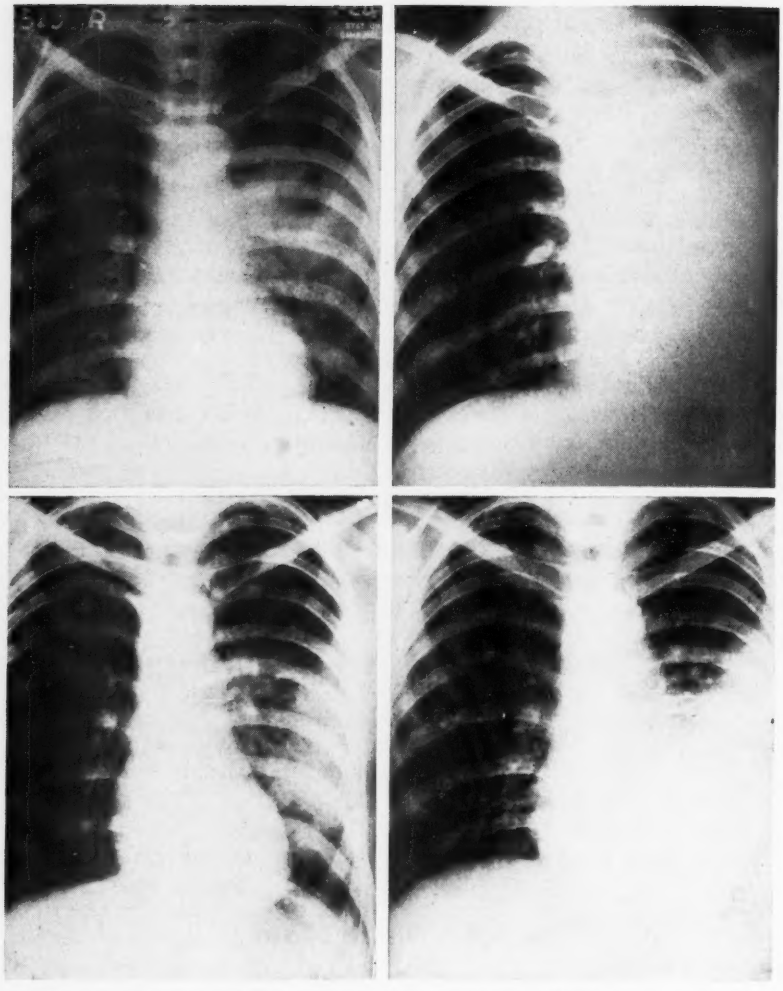

FIG. 1.—Case 1: Serial roentgenograms of a patient with pulmonary actinomycosis, demonstrating the progression of the infection over a period of one year, in spite of adequate treatment with both sulfadiazine and penicillin during this period of time.

(A) Roentgenograms taken January 24, 1944, one month following onset of illness, demonstrating cavitation in the midportion of the left lung.

(B) Roentgenograms taken November 2, 1944, demonstrating an extension of the pulmonary suppuration.

(C) Roentgenograms taken February 10, 1945, demonstrating further extension of the pulmonary suppuration while taking both sulfadiazine and penicillin. Residual lipiodol can be noted in the lower lobe of the right lung.

(D) Roentgenograms taken two months following pneumonectomy, February 12, 1945.

use of the extrapleural plane. At one point a pulmonary abscess was opened, with some contamination of the pleura. The lung was hard and firm, having the consistency of liver. The hilar structures appeared less involved and their dissection was not particularly difficult. The day following operation, and for the next several days, cultures from the previous bronchoscopic and sputum specimens were reported showing the presence of *Actinomyces bovis*. The pathologic examination of the lung showed extensive areas of suppuration and consolidation. There were multiple minute abscesses. The granulation tissue was particularly vascular and the actinomycotic colonies were demonstrated. Because of the demonstration of actinomycosis, and the presence of contamination at the time of the pneumonectomy, a combination of penicillin and sulfadiazine was given both systemically and intrapleurally for a period of ten days. The daily systemic dosage was four grams of sulfadiazine and 200,000 units of penicillin. The daily intrapleural dosage was four grams of sulfadiazine and 100,000 units of penicillin. Pleural fluid developed rapidly, and in large amounts, requiring the daily aspiration of 500 to 800 cc. for a period of a week, in order to maintain the mediastinum in the midline.

The patient's postoperative course was otherwise uneventful. A letter from the patient six months postoperatively stated that he was in good health. It is too soon to make any definite statement, but the prognosis appears to be good.

COMMENT.—This patient serves to illustrate the chronicity of pulmonary actinomycosis, and its possible resistance to therapy. In all such cases, fungous infection should be suspected and the proper examinations made. In this particular instance, the actinomyces were unusually slow in growing culturally. The value of pulmonary resection when other therapeutic measures have failed is also demonstrated. It is felt that both sulfadiazine and penicillin, used in large dosage postoperatively, are a valuable adjunct to the surgical procedure.

Case 2.—The patient, a 24-year-old colored male, had a number of teeth extracted in May, 1944. During the following month he noted a cough, productive of bloody sputum. The temperature during the first month of his illness ranged from 101° to 102°F. The white blood count varied between 14,000 and 23,000. Roentgenologic studies showed evidence of pneumonitis, with areas of rarefaction in the apex of the right upper lobe. The patient was thoroughly studied for tuberculosis, but all studies were negative. Several sputum examinations were suggestive of fungous infection, but no fungus was identified. The patient was treated with sulfadiazine, and a blood level of ten milligrams was maintained. After one month he felt somewhat improved, and the sulfadiazine was discontinued. In spite of the symptomatic improvement, the temperature during August ranged between 99° and 100°F. Roentgenograms showed no improvement. During the next several weeks the sputum and cough gradually increased. The patient noticed considerable pain in the right chest, particularly on inspiration. Intramuscular penicillin was then administered for a month (25,000 units every three hours, for a total dosage of 6,000,000 units). Because of the suggestive evidence of fungi, potassium iodide was given. Following this therapy, there was again a remission, but as before there was no appreciable change in the disease noted in the right lung field, so the patient was again placed on sulfadiazine, four grams a day, and maintained on this dosage until admitted to Kennedy General Hospital in November, 1944. Admission roentgenograms showed considerable improvement, and, symptomatically, the patient was better. He was bronchoscoped November 25, 1944. The right upper lobe orifice was hyperemic and granular. A foul-smelling exudate escaped from this orifice, from which a culture was taken. This, later, showed *Actinomyces*. This remission lasted until the

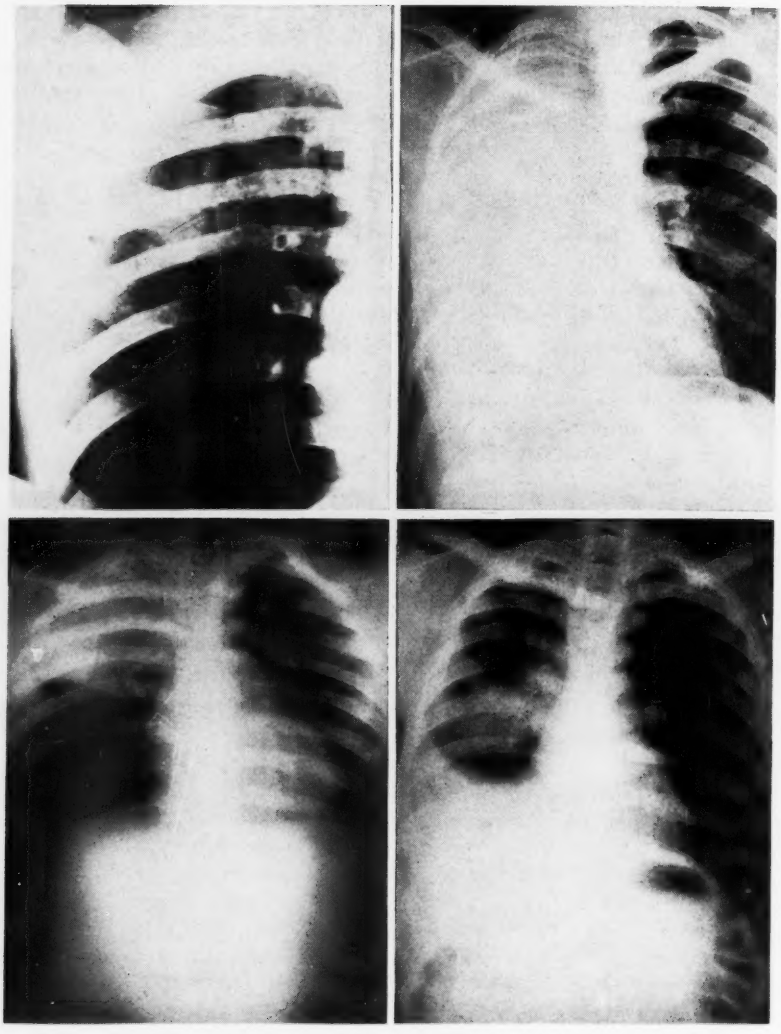

FIG. 2.—Case 2: Serial roentgenograms of a patient with pulmonary actinomycosis demonstrating the progression of the infection over a period of a year, in spite of adequate treatment with sulfadiazine and penicillin.

(A) Roentgenograms taken December 10, 1944, demonstrating pulmonary actinomycosis in the apex of the right lung.

(B) Roentgenograms taken February 26, 1945, during an exacerbation demonstrating some atelectasis as well as pneumonitis in the upper lobe of the right lung.

(C) Roentgenograms taken five weeks after a right upper lobe lobectomy and segmental resection of the dorsal lobe area of the right lower lobe demonstrating a recurrence of the actinomycosis in the basal segment of the lower lobe.

(D) Roentgenograms taken two months following completion of the pneumonectomy, on May 14, 1945.

middle of December, at which time all of the previous symptoms became aggravated, and the roentgenograms showed an increase in infiltration in the right upper lobe (Fig. 2A). Sputum studies revealed the presence of *Actinomyces bovis* in large numbers on direct smear examination and by culturing.

On December 10, 1944, four grams of sulfadiazine a day was again given. There was no significant benefit after 20 days, so intramuscular penicillin (25,000 units every three hours) and increasing amounts of potassium iodide were given, in addition to the sulfadiazine, for a period of three weeks. This therapy was discontinued for two weeks and then begun again on January 23, 1945, and continued for another three weeks—a total of 8,000,000 units of penicillin having been given. There was only

FIG. 3.—Case 2: Surgical specimen of the right upper lobe and dorsal segment of the right lower lobe, demonstrating the multiple abscesses and sinuses. Arrows designate the longitudinal fissure.

moderate symptomatic improvement. The patient was again bronchoscoped January 20, 1945, and similar findings were noted. Roentgenologically, there appeared more localization of the disease process in the right upper lobe. Within two weeks of discontinuing the chemotherapy, the patient became acutely ill. The sputum increased to four to five ounces daily, and was very foul-smelling, and bloody. The temperature spiked to 104° to 105°F. daily. There was severe pleural pain. Penicillin and sulfadiazine were given, in dosages as above, but the patient remained acutely ill for about ten days. The roentgenograms during this period of time showed an extension of the pneumonic process, with some evidence of atelectasis in the right upper lobe (Fig. 2B).

For the next month there was some improvement symptomatically and roentgenologically. During this time he continued to get both sulfadiazine and penicillin. However, it became apparent that chemotherapy alone could not hope to cure this patient. In view of the apparent excellent results by pulmonary resection in the previous patient with pulmonary actinomycosis, it was felt that a permanent cure could be attained in this patient only by operative therapy, in combination with chemotherapy. Because of the diffuse nature of the disease and the type of infection present, operative therapy by pulmonary resection, rather than drainage, appeared to be the procedure of choice. Roentgenologically, the disease appeared confined to the right upper lobe, so resection of this lobe was contemplated. On April 5, 1945, the patient was explored.

As in Case 1, the disease was considerably more extensive than indicated roentgenologically. The pleural surfaces were edematous in some places, while in other areas they were exceedingly adherent as a result of inflammation and fibrosis. This made dissection considerably more difficult. The upper lobe was hard and indurated. Several areas of fluctuation could be palpated. The longitudinal fissure was obliterated posteriorly by what appeared to be an abscess in the base of the upper lobe communicating with a similar one in the dorsal segment of the lower lobe. The basal segment of the lower lobe and middle lobe appeared normal. An upper lobe lobectomy and segmental resection of the dorsal segment of the lower lobe was performed as a unit. Ten grams of sulfadiazine and 200,000 units of penicillin were placed in the pleural space prior to closing.

Pathologic examination of the resected pulmonary tissue showed multiple gangrenous abscess cavities, as noted in Figure 3, with sinuses burrowing from one abscess to another. The walls of the abscesses were both necrotic and fibrotic in areas. There was an hemorrhagic exudate in which the sulfur granules were easily demonstrated. Microscopically, the granulation tissue was extremely vascular and densely packed with plasma cells. The patient was treated postoperatively with six grams of sulfadiazine and 400,000 units of penicillin (intramuscularly) daily in divided doses.

The postoperative course was relatively uneventful with early reëxpansion of the residual lung tissue and obliteration of the pleural space. However, in approximately two weeks time, the sputum increased, and was again found to contain *Actinomyces*. There was a daily elevation of the temperature to 100° to 101°F. Serial roentgenograms during the next four weeks showed increasing infiltration in the basal segment of the residual lower lobe as shown in Figure 2C. It was felt that this represented a recurrence of the actinomycosis, in spite of the massive dosage of chemotherapy the patient was still receiving. Consequently, on May 14, 1945, the remaining portions of the lower lobe and middle lobe were removed. The pleural surfaces noted at the second operation were similar to those originally. Technically, the operation was no more difficult. Five grams of sulfadiazine and 200,000 units of penicillin were again placed in the pleural space prior to closing. Pathologic examination of the lower lobe confirmed the recurrence of the actinomycotic process. Postoperatively, the patient was treated with sulfadiazine and penicillin, administered both systemically and intrapleurally, as in the first patient. It was also necessary to aspirate approximately 500 cc. of fluid daily for ten days to maintain the mediastinum in the midline. Intrapleural chemotherapy was continued for two weeks. The patient's postoperative course was entirely uneventful. A check-up examination over a year postoperatively showed the patient to be well.

Discussion.—This patient illustrates a number of interesting features. The first is the periodicity of the relapses and remissions. Chemotherapy was of considerable value during the periods of exacerbation but did not appear to significantly influence the course of the disease, as a whole. In spite of intensive chemotherapy the disease was progressive. It became apparent that chemotherapy, alone, could not cure this patient — so pulmonary resection was resorted to. It is interesting to note that the extent of the disease process was also greater than suggested by roentgenograms preoperatively. It was instructive to us to find that segmental resection is unwise in such infections because of the inability to detect grossly, or roentgenologically, the entire extent of the disease. In case of any doubt total pneumonectomy should be performed. The other advantages of pneumonectomy are described.

SUMMARY AND CONCLUSIONS

Two case histories of patients with pulmonary actinomycosis are presented. Both patients were treated with intensive courses of sulfadiazine and penicillin therapy, used both alone and in combination, almost continuously, over a period of one year. This therapy appeared to be of value only during the periods of exacerbation and had no permanent effect upon the progress of the disease, as a whole. After a year's therapy in both patients without significant benefit, apparent successful results were attained following pneumonectomy. During the postoperative period intensive therapy, employing sulfadiazine and penicillin both systemically and intrapleurally, was used. It is felt that patients with pulmonary actinomycosis who fail to improve upon intensive, adequate courses of chemotherapy should be treated by pulmonary resection while the disease is still limited to the lung and before the development of multiple thoracic sinuses.

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MANAGEMENT OF INJURIES TO STENSEN'S DUCT

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IT IS A GENERALLY ACCEPTED FACT that surgery for repair of lacerations or injuries of Stensen's duct has been notoriously unsuccessful. All too often, it results in complete failure. Despite this gloomy prognosis, occasional cases of successful immediate repair have been reported, but few, indeed, are the reports of success in the treatment of the more chronic types of fistulae.

There are several reasons for this state of affairs. The injury is so rare that no one individual has acquired any considerable experience in this field. There are inherent difficulties in the peculiar anatomy and relations of Stensen's duct which make surgery hazardous. Although many of the operations and procedures described are excellent in principle, none are complete. Furthermore, a comprehensive pre- and postoperative regimen has never been published.

The authors have been fortunate enough to have encountered a number of duct injuries while on duty at an Army General Hospital during the years 1943, 1944 and 1945; and, as a result of this experience, an operation and general system of care for these cases have been developed. No claim of originality is made; the operation has been described in principle by Tees,[1] Glascock,[2] and others.[3-7] It is felt, however, that the complete and detailed description of the care of these cases represents a contribution worthy of publication, inasmuch as a cure in every case, even fistulae of prolonged duration, was accomplished in the series herein reported.

ANATOMY

Stensen's duct is formed by the convergence of several branch-duct tributaries within the substance of the gland. It leaves the anterior border of the gland at its most prominent part to run forward in an horizontal direction across the masseter muscle below the accessory parotid gland. It is accompanied by branches of the facial nerve and the transverse facial artery which are commonly some distance above it, though this relationship is variable. At the anterior border of the masseter it passes abruptly inward, piercing the pad of fat and buccinator muscle; then forward for five to ten millimeters to emerge through a narrowed orifice in the papilla opposite the second upper molar tooth. Its course is rather constant. It can be marked by a line extending from the inferior border of the external acoustic

meatus to a point midway between the ala of the nose and the upper border of the upper lip. The duct measures on an average of six to seven centimeters in length and four to five millimeters in diameter, but at the orifice it narrows to a point where it admits only a fine bristle. The walls are fibrous, thick and resistant and do not collapse. The fibrous coat contains contractile tissue which ejects saliva during mastication. The duct is lined by mucous membrane of short columnar epithelium.

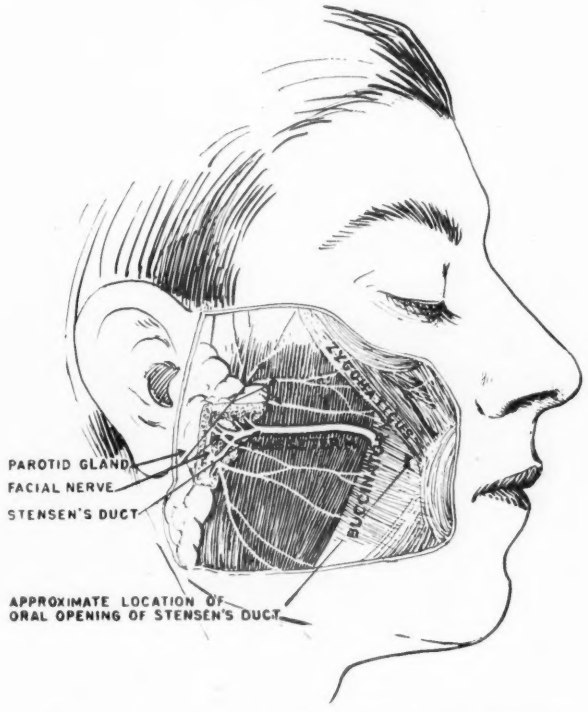

FIG. 1.—Anatomic sketch illustrating the relationship of Stensen's duct to the surrounding structures. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

The papilla is a complex mechanism which functions both as a sphincter and a valve. The contraction of elastic tissue holds back the saliva, for the most part; during mastication, relaxation occurs and allows the saliva to enter the mouth. This illustrates the sphincteric action. The valve is formed by a sharp angulation of the duct as it approaches the buccal surface of the papilla. This is easily demonstrated during the dilation and probing. The function of the valve is to prevent the contents of the mouth from gaining entrance to the duct.

TREATMENT

Treatment of parotid duct fistulae, and injuries, may be conveniently divided into three categories depending upon the anatomic location: 1. Fis-

FIG. 2.—The end result of spontaneous healing following severe injury to Stensen's duct. The injured portion of the duct is embedded in a mass of scar tissue with the lumen of a portion of the distal segment obliterated by the cicatrix. The proximal segment is patent and is secreting saliva. This condition prevailed in Cases 2 and 3. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

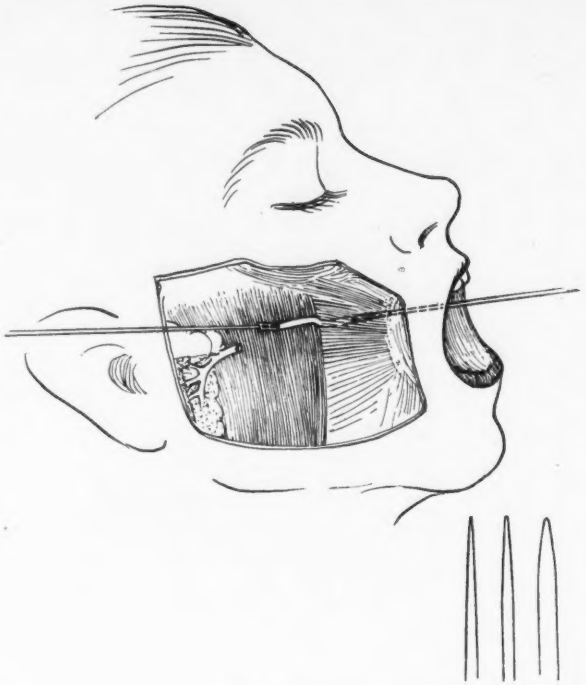

FIG. 3.—The intra-oral and the external probes are in position. The mass of scar tissue and the cicatrixed portion of the distal segment have been excised. The metal dilators drawn to scale, are shown in the lower right hand corner. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

tulae in the glandular area. 2. Fistulae over the masseter muscle. 3. Fistulae anterior to the masseter muscle, or in the buccinator muscle area.

1. *Fistulae in the Glandular Area:* These, if connected with the main duct or a main branch tributary, are best treated by surgery (as described below). If they arise from minor tributaries, however, a number of methods may be employed. (a) Spontaneous healing: This occurs rather frequently if the tributary duct communicating with the fistula is small. As a rule,

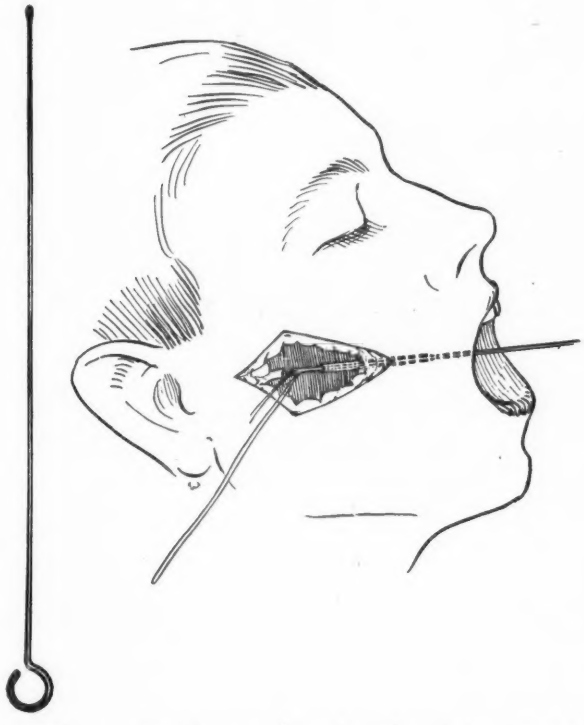

FIG. 4.—The intra-oral probe after being passed through the distal segment is threaded with the tantalum wire. The probe used is illustrated here. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

infection of the acini supplying this minor duct occurs, followed by atrophy or disintegration with cessation of secretion, or the fistulous tract becomes occluded by a constricting cicatrix. Moreover, mechanical occlusion of the main duct or any of its tributaries is followed by atrophy of the supplying acini.[2] (b) Cauterization: Chemical cauterization with silver nitrate, phenol or actual cautery has been recommended. Roentgenotherapy has been found quite successful in the treatment of minor glandular fistulae. (c) Excision of the gland: This is an extremely difficult operation; a procedure of this magnitude would be unjustified in minor fistulae. There are better methods of treatment for fistulae connected with the main duct.[8] (d) Avulsion of nerves:[9] Avulsion of the auriculotemperal nerve has been advocated. This

FIG. 6.—The twisted tantalum wire is in its correct position. It occupies the lumen of the proximal and distal segments of the duct and the gap between these segments. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

FIG. 5.—The twisted tantalum wire has been drawn through the distal duct segment and is now being inserted into the proximal segment. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

procedure, or section of the glossopharyngeal nerve itself, will eventually bring about acinar inactivity and, therefore, should result in a cure. Such procedures are too radical because cures may be effected by less involved methods. Thus, there are three choices in the treatment of glandular fistulae other than by surgery: Allow a reasonable time to pass in the hope of spontaneous healing. Try cauterization by chemical or actual cautery. Destroy the function of secretion by roentgenotherapy.

2. *Fistulae over the Masseter Muscle:* Although no figures are available and no reported series is large enough from which to draw any conclusions, a study of the anatomy and search of the literature suggests this to be the

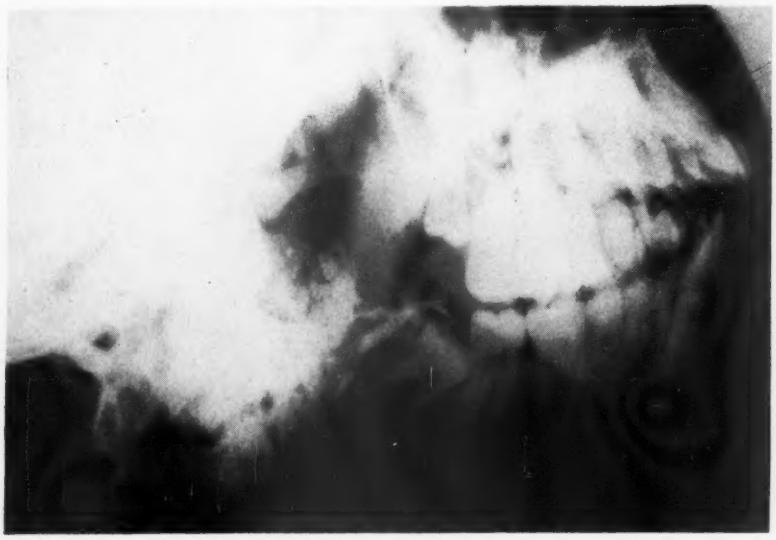

FIG. 7.—Case 1: Preoperative lipiodol study showing that both proximal and distal segments of the left parotid duct are patent. There is a normal distribution of the lipiodol throughout the acini of the gland. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

most frequent site of traumatic fistula. The duct is relatively superficial; in some individuals it can be palpated against the tensed masseter. If the laceration is recent, it should be sutured immediately using the technic described below. A fistula of months', even of years', duration does not contraindicate surgery, however. One of our cases had had a fistula for 14 months, yet it responded to surgery promptly. Brown, Kuttner, and Crouse have described operations in this region using buccal mucous membrane flaps to create a duct which is then attached to the proximal segment.[8] Such procedures may succeed but are, in the opinion of the authors, unnecessarily complicated and involved.

3. *Fistulae Anterior to the Masseter Muscle or in the Buccinator Muscle Area:* Fistulae in this area seem to be rare. They may be repaired by several operations which depend upon the conversion of the external fistula

into an internal, or oral one. Such operations have been described by von Langenbeck, DeGuise, Kaufman, and others.[8] All of these operations have the same fault. They short-circuit the distal end of the duct and the duct papilla. Thus, the duct papilla with its valve-like action is lost, and there is no bar to ascending infection which promptly results. Two of our cases illustrate this point. (Cases 4 and 5.) In view of this experience, the authors feel it is essential that the papilla be preserved because of its pro-

FIG. 8.—Case 2: Lipiodol was first injected through the oral opening of the right parotid duct and resulted in a wide spread of the lipiodol into the soft tissues of the face. An attempt was then made to instill lipiodol into both distal and proximal segments externally through the fistulous opening. This resulted in failure to visualize the distal segment. The proximal segment is clearly outlined. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

tective action. This is accomplished in the operation recommended by the authors.

OPERATIVE PROCEDURE

(A) *Prior to Surgery:* The following steps should be carried out:

1. Lipiodol should be injected into the fistula, and into the oral opening. A study of the resulting radiographs will frequently give much valuable information.

2. For a period of approximately ten days, the oral opening in the papilla should be dilated daily, and the duct probed as far as possible with flexible graduated probes.

3. Twenty-five thousand units of penicillin should be administered intramuscularly every three hours beginning 24 hours before surgery.

(B) *Surgery:* Intratracheal anesthesia is ideal. The throat can be blocked off and the operation, which requires an intra-oral field as well as an external field over the cheek area, can proceed unhampered.

Step I: The opening in the papilla is dilated and a flexible probe is introduced as far as possible. This probe may be arrested at the point where the duct curves over the masseter muscle even though the fistula is some distance posterior. After the cheek is opened, the probe can be manipulated under direct vision for a distance further along the duct. A second probe is now introduced into the fistula and worked anteriorly through the duct as far as possible.

FIG. 9.—Case 3: Oral injection of left parotid duct with lipiodol visualized only a small narrowed portion of the distal segment. Some lipiodol has diffused into the soft tissues. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

Step II: With the probes in place, an incision, using the ends of the two probes as landmarks, is made through the cheek. This brings the operator directly down upon the duct, or the remnants thereof. Considerable care should be exercised in making this dissection. In one of our cases an important branch of the 7th nerve lay directly over the duct and necessitated retraction before adequate exposure could be obtained.

Step III: After the ends of the proximal and distal probes have been located, an attempt is made to pass them through the duct to effect a junction. Sometimes, an adhesion or a single cicatricial band causes the obstruction which will give way under gentle pressure. However, where the duct is completely severed and both ends are sealed, the ends are incised; the proximal probe is withdrawn and the distal probe is passed through the remainder of the duct and out the fistulous opening.

Step IV.: The probe, with its tip at the fistula, is threaded with No. 10 tantalum wire twisted upon itself and then pulled anteriorly out through the oral opening. The wire now lies in the distal segment of the duct.

Step V: The proximal end of the twisted tantalum wire is next threaded along the duct proximal to the fistula so that it lies well beyond this opening into the origin of the duct or one of its main tributaries. By patient probing, no difficulty has been met in finding the opening of the proximal segment.

Step VI: The fistula and any portion of the twisted wire dowel which lies exposed are carefully closed with fine (No. 000) catgut and as many layers of covering are formed as possible.

FIG. 10.—Case 3: External injection of lipiodol through the fistulous opening shows the distal segment completely blocked. The proximal segment is patent. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

Step VII: The distal end of the twisted tantalum wire is then brought out through the mouth and is fastened to the skin of the cheek with a suture or adhesive tape. It is moved slightly back and forth daily; and in three or four weeks is removed by gently withdrawing it.

(C) *Postoperative Care:* Administration of 25,000 units of penicillin intramuscularly, every three hours, is started immediately; starting with the day following operation, patients are given pilocarpine hydrochloride,

10 milligrams, three times daily, at 10 A. M., 3 P.M., and 8 P.M. In addition ammonium chloride, Gm. 1, is given with each meal. Large quantities of fluids (a minimum of 3,000 cc. daily in addition to that taken with meals) are advised. The ammonium chloride is given for three days and omitted for two days. Oral hygienic measures are most important during the postoperative period.

DISCUSSION.—In recent injuries where the duct is completely severed, repair in the manner described is advised. By probing the duct from the

FIG. 11.—Case 4: A defect in the outline of the left parotid duct produced by a salivary calculus. Lipiodol was used to visualize the duct. A salivary calculus 4 mm. in diameter was later removed at operation. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

oral papilla, the proximal end of the distal segment can be located and it can be sutured to the distal end of the proximal duct which is identified by expressing saliva with gentle pressure over the gland. The wire dowel should be used as described; if not, the opening in the oral papilla should be dilated daily to encourage free flow of saliva along the normal channel. This same procedure, without the use of a dowel, will suffice in cases of surgical incision for stone (Case 4).

Tantalum was chosen as a dowel because of its benign effect on tissues. Any other wire which exhibits similar properties could be used for this purpose. Stainless steel or vitallium would, no doubt, be efficacious. One of the authors (D.B.S.) while following a technic, described by Thatcher,[10] has used stainless steel, acrillic, glass and tantalum buried in fingers and has so formed new tendon sheaths where a hopeless destruction had resulted from trauma and infection. In these cases a smooth sheath formed in three weeks. For this reason the authors advocate the retention of the tantalum dowel within the duct for at least three weeks. This is most important in

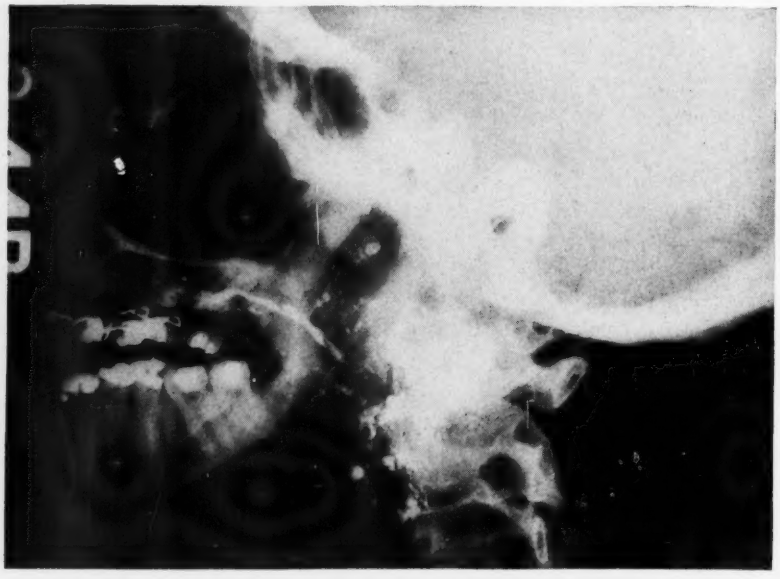

FIG. 12.—Case 5: Severe chronic infection of left parotid gland following excision of duct papilla in a case of mild recurrent sialadinitis. Note the puddling of the lipiodol. (Management of Injuries to Stensen's Duct—Newman & Seabrook.)

cases where an entirely new segment of the duct must be formed.

The use of wire as a dowel follows a principle described in the literature. Any dowel, such as a ureteral catheter, which blocks the flow of saliva tends to defeat the essential purpose, which is to establish a flow of saliva along the repaired duct. The daily manipulation, back and forth, of the twisted tantalum dowel tends to prevent stasis and prevents secretions or blood clots from blocking the channel around the course of the twisted tantalum wire. The dilators and special probe designed by one of the authors (S.C.N.) tend to make the operation a comparatively simple procedure.

Furstenburg and Crosby[11] have shown that the use of pilocarpine and ammonium chloride increases the salivary flow; observation has convinced the authors that the viscidity is considerably reduced under this regimen. Thus, the thick, tenacious parotid secretions (often containing pus) soon

become thin, clear, and free-flowing. Once this has been accomplished and saliva is definitely entering the mouth along the tantalum dowel, a cure can be anticipated.

It is not unusual to have the fistula reopen for a short period of time after surgery but if the dowel is guiding saliva along the duct into the mouth, the fistula will close spontaneously. It has been the policy of the authors to seal the reopened fistula with adhesive tape. In the two cases in which this complication occurred a rapid healing was obtained in a few days.

CASE REPORTS

Case 1.—Rifleman, age 20: At Aachen, Germany, November 20, 1944, the patient received shell fragment wounds of the left side of the face, the head, and the right leg. He came under our observation on February 15, 1945. All wounds were healed except for persistent salivary fistula of the left Stensen's duct in the masseter area. Lipiodol roentgenologic studies were made, and showed that both distal and proximal segments of the duct were patent throughout their entire length.

On April 9, 1945, a modified Kaufman operation was performed to establish an intra-oral fistula, and a ureteral catheter was inserted as a dowel. The external fistula was excised and the wound closed. On the fourth postoperative day, the wound broke down and fistula reëstablished itself. Because the intra-oral fistula drained little, it was felt that the catheter contributed to the obstruction of the salivary flow. The catheter was, therefore, removed, and the distal segment of the duct was dilated and probed through the normal orifice daily. The next day, saliva was seen entering the mouth through the papilla. Continued dilating and probing of the duct and the application of pressure to the external fistula closed the fistula four days later. The flow of saliva continues through its new channel. Experience derived from this case determined the course of procedure in the following cases (Cases 2 and 3).

Case 2.—First Lieutenant, Tank Battalion, age 26: In July, 1944, at St. Lo, France, the patient received a penetrating wound of the right side of the face which resulted in a persistent salivary fistula in the masseter area. Despite this, the patient continued on duty until June 3, 1945, when a kick by a horse fractured his left wrist. For this latter injury, he was evacuated to the Zone of Interior, and came under our observation July 30, 1945. The fistula had been discharging saliva since the original injury; the flow was markedly active after meals. Roentgenologic studies, with lipiodol injected into the oral orifice, showed only a small amount of lipiodol entering the duct, but there was considerable extravasion into the soft tissues of the face. Lipiodol injected into the fistulous opening made clear the duct system posteriorly but no lipiodol was seen anterior to the fistula. It was, therefore, determined that that portion of the duct was occluded. The operation described by the authors was performed September 19, 1945. The postoperative course was uneventful except for the formation of a marble-sized cystic swelling over the wound. This disappeared after several aspirations. The dowel was removed after three weeks.

Case 3.—Infantry Rifleman, age 22: On April 22, 1945, on Okinawa, the patient was hit in the left side of the face by a mortar shell fragment; a left parotid fistula over the masseter area resulted. He came under our observation on July 9, 1945. Lipiodol studies revealed obliteration of the distal part of the duct except for a narrowed terminal portion with multiple sinuses which lead into the soft tissues. The patient was operated upon on September 19, 1945. Convalescence was uneventful except for a temporary reopening of the fistula. This closed spontaneously in four days. The dowel was removed in three weeks.

Case 4.—Infantryman, age 22: This patient was first seen on January 15, 1944. His history revealed recurrent attacks of swelling of the left parotid gland. The present attack was of three weeks' duration. Roentgenologic studies showed a stone in the masseter area of Stensen's duct. This was removed by operation, on February 1, 1944. The duct was sutured with fine silk and the tissue was closed in layers. No dowel was used, but other features of the recommended postoperative treatment were carried out. Convalescence was uneventful.

Case 5.—Air Corps Mechanic, age 20: This patient gave a history of recurrent infection of the left parotid gland. During the course of the most recent attack, the attending surgeon had removed the papilla in order to enhance drainage. Severe and continued infection of the gland followed. Such was the condition when the patient came under our observation. Despite all forms of local and systemic therapy, the infection continued unabated. Symptoms could only be relieved by complete destruction of the gland, which was accomplished by deep roentgenotherapy. It is the author's opinion that removal of the papilla with the resultant exposure of the duct to the continuous contamination from the oral cavity so aggravated the condition that the entire gland had to be sacrificed.

CONCLUSIONS

1. Salivary fistulae of the parotid gland and duct respond to appropriate treatment regardless of chronicity.

2. An operation and a system of preoperative and postoperative care are described.

3. The importance of preserving the duct papilla is stressed.

The authors gratefully acknowledge the splendid coöperation of Miss Susan H. Wilkes, of the Vanderbilt University School of Medicine, in the preparation of the illustrations in the limited time allotted.

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MASTECTOMY FOR GYNECOMASTIA THROUGH A SEMICIRCULAR INTRA-AREOLAR INCISION*

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GYNECOMASTIA, or abnormal enlargement of the male breast, is a condition in which the appearance of the breast simulates that of the female. The condition may be unilateral or bilateral. An operation for its correction is herewith presented which has been employed on 32 breasts in a series of 17 cases. This paper does not deal with the surgical treatment of the malignant type of male breast hypertrophy.

Temporary swelling of the male breast may occur at puberty or during adolescence and this may recede spontaneously without requiring treatment. There are cases of gynecomastia occurring usually in adults with associated hyperplasia or tumors of the adrenal cortex. Removal of the tumors causes reduction of the size of the breasts.[1-4]

There are three classes of benign hypertrophy of a permanent nature which necessitate treatment: (1) Periductal connective tissue hypertrophy without adipose tissue change; (2) increase in the amount of both of these elements; and (3) adipose tissue hypertrophy alone.

In the first group the mammary gland is hypertrophied to form a firm discrete nodule beneath the areola and adjacent skin. A well-defined white fibrous tissue is found on gross examination, while microscopic examination reveals elongated ducts and ductules surrounded by a mass of connective tissue and complete absence of adipose tissue within the nodule. The intraductal epithelium may be hypertrophied so as to form projections into the lumens of the ducts, but with no evidence of malignant changes. No true acini are found as in the female mammary gland, although terminal ductules may somewhat resemble those acini. The condition is either unilateral or more commonly bilateral, and it usually appears at puberty.[5-7] The patients in this group have the normal male type of body and genitalia and the firm gland is readily palpable as a nodule.

In the second, or intermediary group, the connective tissue elements may be predominant or they may exist only in small amount in the region beneath the areola with the remainder of excess tissue composed of adipose tissue. The body may be of the feminine type, eunuchoid, or of the normal male type. The genitalia may be normal or underdeveloped, with atrophy of the testicles from various causes. One or both breasts may be involved and ordinarily a subareolar nodule can be palpated. Onset is commonly at puberty but may be postponed until later in life.

*Presented before the combined meeting of The New York Surgical Society and The Philadelphia Academy of Surgery, February 14, 1945.

In the third group the increase in size of the breast is due entirely to excessive adipose tissue with no mammary gland hypertrophy. The body is of the Froehlich type and the genitalia are underdeveloped until late in

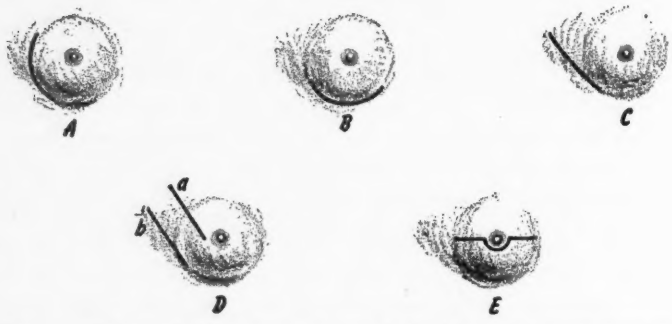


FIG. 1.—Schematic diagrams of simple incisions in extra-areolar skin for male mastectomy as reported in the literature.

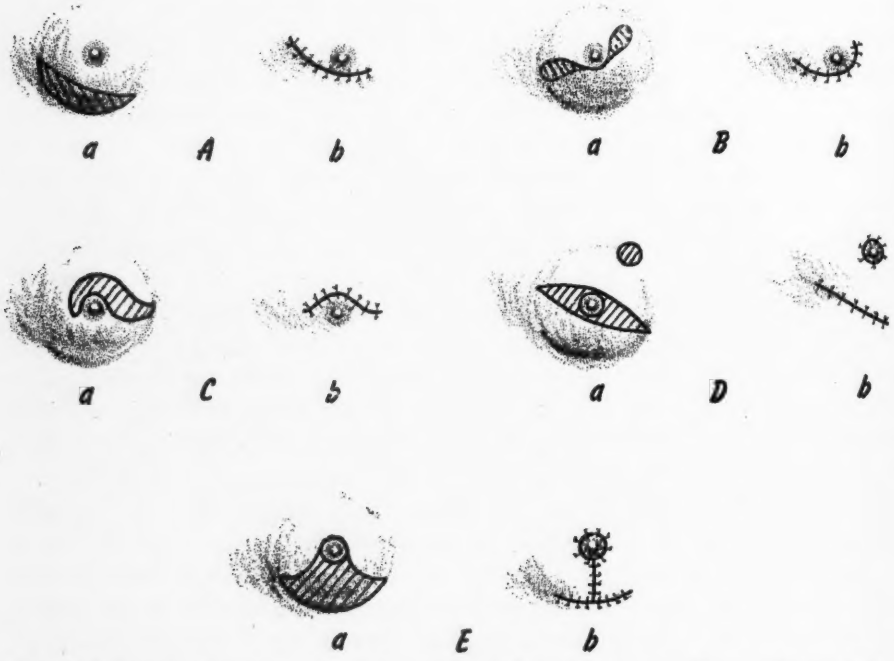


FIG. 2.—Schematic drawings of more complicated operative procedures advocated by various surgeons.

puberty, when they generally attain normal size. The condition is bilateral and appears in the first decade of life, but usually does not cause the patient concern until the age of puberty. No nodule is palpable beneath the areola.

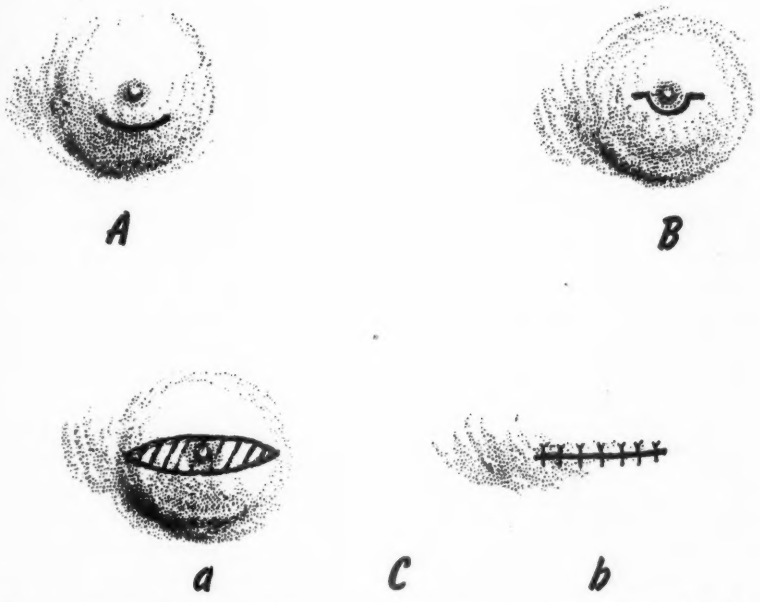


FIG. 3.—Unreported procedures at one time in vogue at the Presbyterian Hospital.

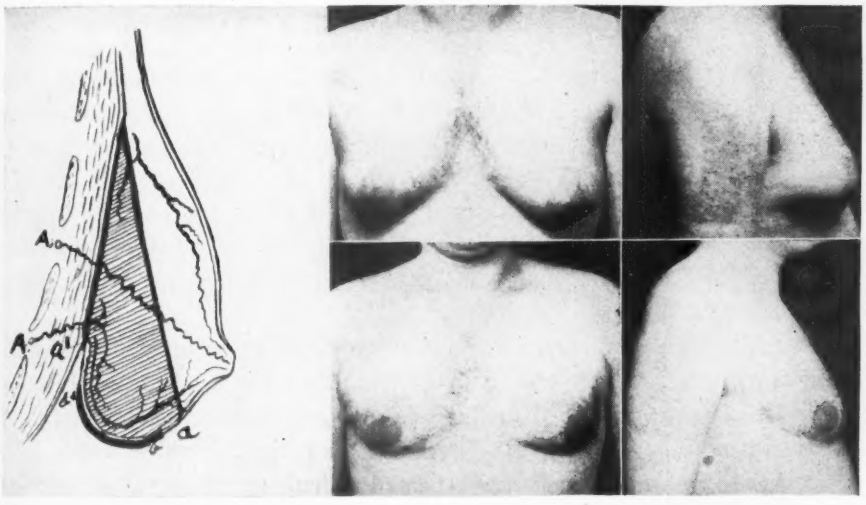


FIG. 4.—Diagram of Maliniac's procedure and illustrations of cases. (From J. Clin. Endocrinol., 3: 364–366, 1943[16])

Methods of treatment advocated for gynecomastia have been radiotherapy, endocrine therapy, and operation. It is now generally conceded that radiotherapy offers no chance of improvement of the condition.[8] Dr. William Schonfeld reported from our Endocrine Clinic that in his experience all types of treatment with various hormones failed to reduce the breast in a single case, even when male sex hormones were injected directly into the breast.[5] It is possible that in the reports of cure by endocrine therapy some of the cases of breast hypertrophy were of the temporary type and would have receded spontaneously even without treatment.[9-11]

Surgical removal of the excess breast tissue offers the best method for the correction of gynecomastia. The indications for operation are: To remove the threat of subsequent malignant changes in the enlarged breast; to relieve pain; and to prevent the psychic trauma caused by the feminine appearance of the breast.

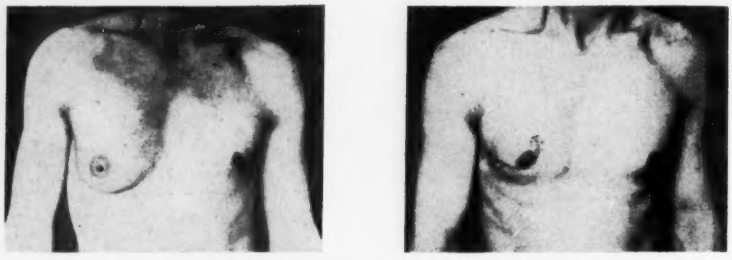


FIG. 5.—Diagram of Vogt's procedure and illustrations of case. (From Chirurg., 10: 322–324, 1941[17])

Carcinoma of the male breast developing late in life occurs extremely rarely, and the number of cases seen is small in relation to the large number of gynecomastia cases. It is readily distinguished from the benign type of mammary hypertrophy.

The complaint of pain as a cause for seeking relief has been recorded,[12] especially by doctors in the Armed Forces — however, one suspects that frequently the true cause for complaint was the unwelcome shape of the breast rather than actual pain.

The psychic trauma caused by "the reproach of effeminacy" is the main reason for operative interference in gynecomastia of the benign type. In modern life when exposure of the body is so frequent, and this is particularly the case in military life,[13, 14] the gynecomastia patient is subjected to jibes and teasing from his fellows. The repeated ridicule may bring about changes in the individual's behavior patterns. He hesitates to undress before others in the gymnasium or on the beach, and he refrains from going in swimming. He may even shrink from exposing himself in a thin undershirt. Thus, a complex is started which may lead to severe psychotic disturbances.

That this deformity causes acute psychic trauma has been recognized for centuries. Paulus Aegineta[15] (625–690 A.D.) described the condition of gynecomastia, which he thought was due to "the formation of fat." In order to improve the mammary appearance he advocated removal of the excess tissue through a single submammary lunar incision or, in marked cases, through two lunar incisions coming together at the ends and with excision of the subtended skin. Ever since the seventh century this procedure has been used extensively, and other types of incision for removal of the excess of tissue have been devised (Figs. 1–7).[16-27] In all the operative procedures we have found reported, the incisions have been made through the moderately thick skin outside of the areola. The skin in this area does not lend itself to ideal healing as scars resulting from incisions in this region, even after meticulous closure, are usually broad and conspicuous. Surgeons have even advocated removal of the entire areola together with the excess of breast tissue to overcome gynecomastia—when operation was admittedly performed to improve the mammary appearance.[1]

FIG. 6-A

FIG. 6-A.—Cases of Campos operated by two procedures.
(From Arq. de Cir. Clin. e Exper., **6**: 703–705, 1942[18])

There is no indication that any surgeon has recognized that the scars resulting from these operations may cause nearly as much embarrassment as the original condition, especially so when the scars are bilateral and symmetrical and explanation of their presence is made more difficult. Nor has an operation been devised that prevents the formation of visible scars that give evidence of operative interference, an ideal which should be sought in order to secure complete success from the psychologic standpoint.

With this object in view, an operation with a semicircular intra-areolar incision was devised by the author, and was first performed in 1934. The results were so satisfactory that the method has been employed in all 15 subsequent cases treated on the Division of Plastic Surgery. In 1944, Comdr. George V. Webster, U.S.N.R., formerly a resident on this Service,

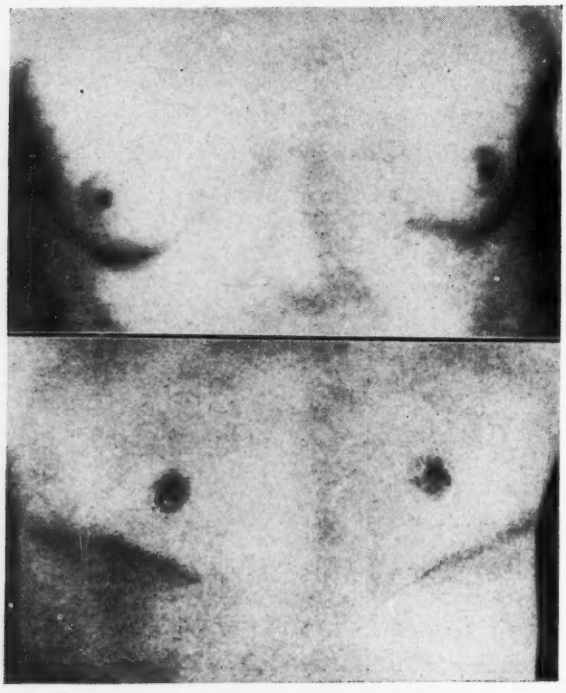


FIG. 6-B.—Cases of Campos operated by two procedures.
(From Arq. de Cir. Clin. e Exper., **6**: 703–705, 1942[18])

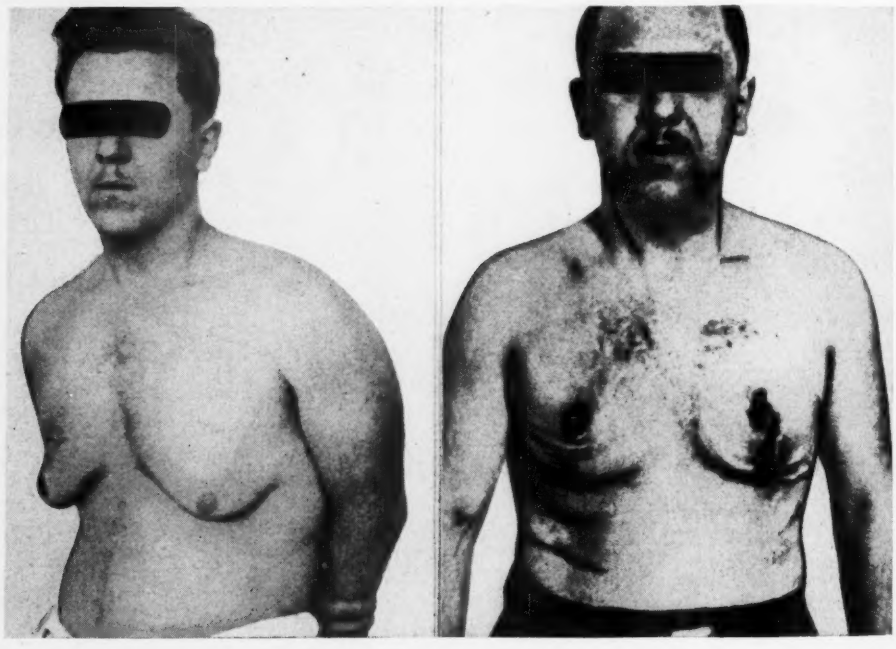


FIG. 7.—Case operated by Adler's method similar to mammaplasty for hypertrophy of the female mammary gland.
(From Zentralbl. f. Chir., **64**: 889–893, 1937[19])

reported the procedure as performed at this clinic and later by him in the Navy.[28]

OPERATIVE PROCEDURE

The operation is performed under general anesthesia. If the condition is bilateral two operative teams are used simultaneously to reduce the length of the operative time. Care must be taken that the procedures used by each operator are similar and that the tissue left remaining on each side is of the same amount so as to obtain symmetrical surface contours.

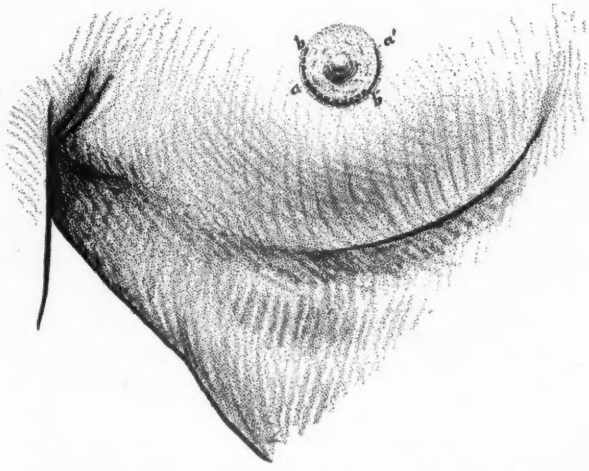
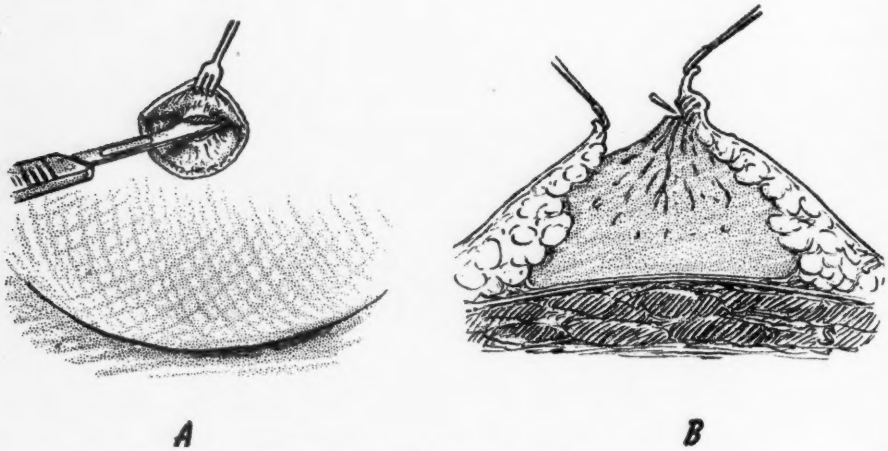


FIG. 8.—The author's operation. Semicircular intra-areolar incision—a-a′ in caudad half of areola; b-b′ in laterocaudad half of areola, to facilitate removal of tissue toward the axilla.

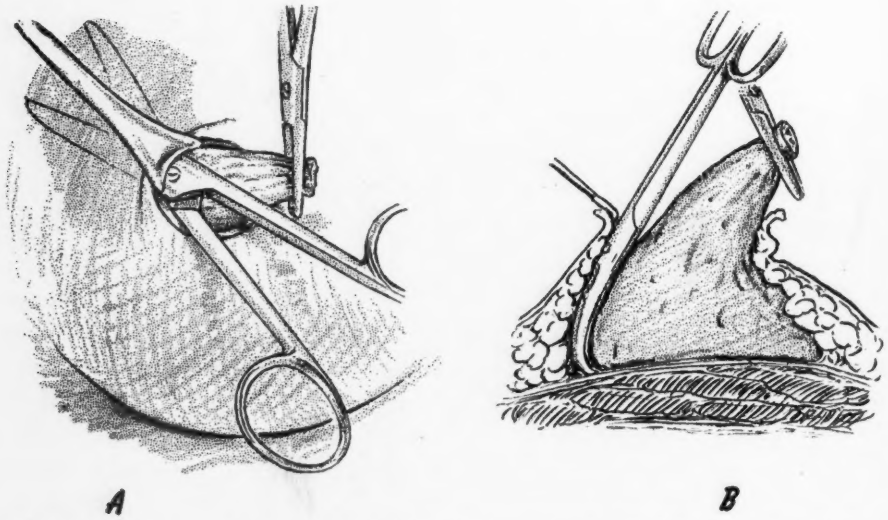
The areola is distended by pressure exerted downwards about the breast by the encircling hands of the assistant. A semicircular incision is made just within the margin of the pigmented area of the areola. It may either extend over the lower, or caudad, half of the areola, or be placed more laterally (Fig. 8) when much tissue towards the axilla has to be excised. Incisions in the areola leave fine inconspicuous scars. If they are made at the outer edge of the areola in the thicker derma the scars will be more evident. Dissection beneath the areola with division of the ducts may be made early to facilitate operation (Fig. 9). Excision is aided by traction upwards with Kocher clamps on the divided ductal stump (Fig. 10) or on the mass of tissue that has been freed. The introduction of a palpating finger and incision against this with curved scissors is helpful. Bleeding points should be clamped and tied early, to reduce the amount of bleeding and improve vision. Enough adipose tissue must be left to be drawn together eventually beneath the nipple if such a layer does not cover the pectoral fascia; incisions

may be made in the adipose tissue between the skin and the remaining cut-surface of adipose tissue for later advancement of a fat layer towards the center.



A B

FIG. 9.—Retraction of areolar flap and division of breast ducts.



A B

FIG. 10.—Excision of breast tissue with traction outwards aided by a Kocher clamp.

If the areola is small in comparison with the amount of tissue to be removed through the incision, the tissue may be halved or quartered and individual portions can be separately removed (Fig 11).

If the periductal connective tissue is well developed, as in Group I, dissection will be comparatively easy. If there is no fibrous tissue plane to

follow and adipose tissue has to be excised, the operator must use his judgment in cutting evenly at a satisfactory depth through the subcutaneous fat so as to remove a cone-shaped mass of tissue tapering away to nothing at the periphery (Fig. 12). Sufficient fat must be left over the pectoral fascia to obtain a smooth, even surface when the remaining tissues are replaced. Reduction of the adipose tissue should be sufficient to overcome the similarity to the female breast, but the amount remaining should not be disproportionate to the amount of subcutaneous fat found elsewhere on the body. In the intermediate type of case a fibrous tissue plane can be followed where this exists, but in proceeding laterally incision must be made without this aid.

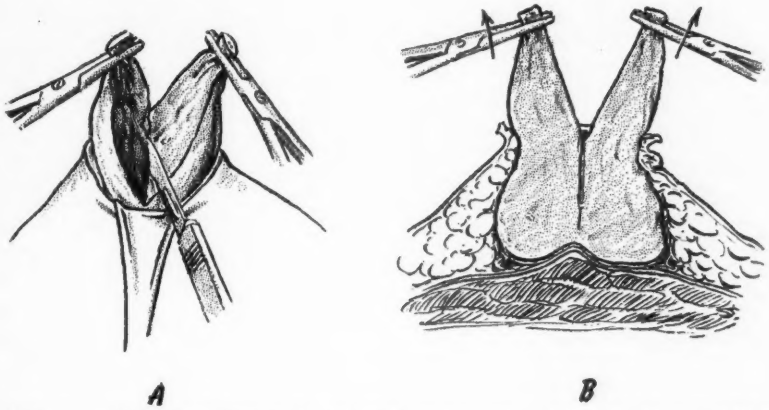


FIG. 11.—Division of breast tissue into two masses to be removed separately.

In closure the use of unabsorbable sutures, such as silk, is recommended, in order to prevent subsequent separation of the tissues which have been brought together. To close the wound satisfactorily is one of the most difficult phases of the operation. By a "trial and error" method the subcutaneous fat is sutured together (Fig. 13) so as to form a uniformly thick layer over the pectoral fascia and in such a way as not to leave the areola distorted after closure. The nipple must not be allowed to adhere directly to to the pectoral fascia, nor must there be a concavity in the mammary region. It is advisable to err slightly on the side of excessive removal of adipose tissue, because what may appear to be sufficient on the operating table when the patient is supine subsequently may appear insufficient when erect. After bringing the subcutaneous fat together (Fig. 14) the wound in the areola is closed in two layers (Fig. 15), so as to approximate smoothly both the lower derma and the skin edges.

If the skin at the edge of the wound has been devitalized through pressure of retractors careful smooth débridement of this tissue must be made. Hemostasis should be adequate and closure without drainage is desirable. A

voluminous dressing with moderately firm pressure from an Ace bandage should be applied. Too much pressure may cause necrosis of the nipple. Postoperative coughing should be encouraged to prevent the possibility of atelectasis.

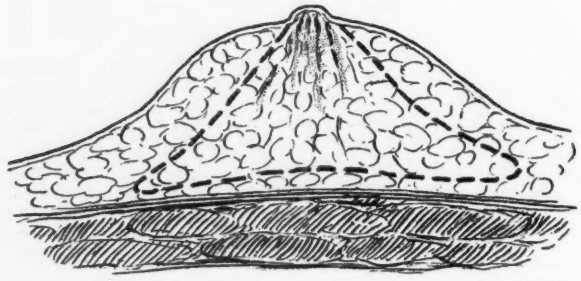


FIG. 12.—Outline of incision in adipose tissue when this is largely responsible for enlargement of the breast.

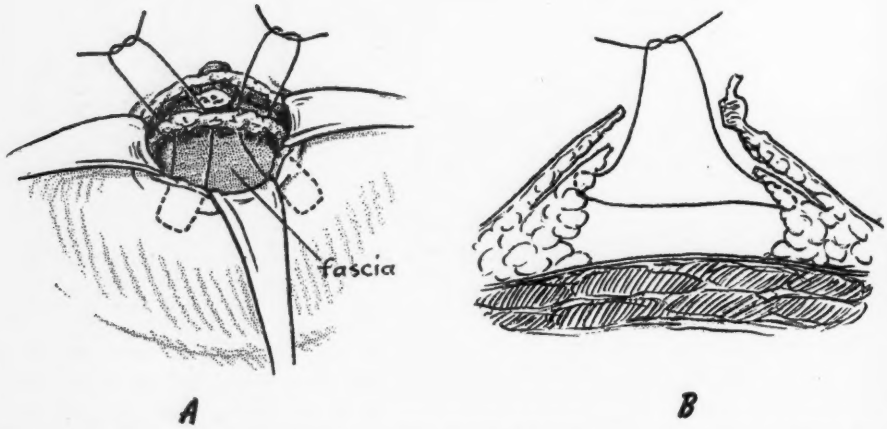


FIG. 13.—Suture of adipose tissue to bring tissue beneath the areola after having made relaxing incisions in subcutaneous tissue.

ANALYSIS OF CASES

In this series of 17 cases there was unilateral hypertrophy on the right side in one patient, Case 12, (Figs. 24 and 25), and on the left in another; the condition was bilateral in the remaining 15 patients, two of whom were colored; thus, a total of 32 breasts were operated upon.

The onset of the condition was said to have occurred from nine years of age to 19, with the onset in ten of the 16 cases during the 12th and 13th years. Those patients exhibiting Froehlich's syndrome showed enlargement of the breasts at an early age, as was to have been expected. Operation was performed in all 17 cases six months to 20 years after the onset of the condition, the average duration of the condition before operation being seven years.

Specimens from two patients, Cases 1 and 15, (Figs. 16 and 17) showed only well-encapsulated periductal connective tissue thickening with no adipose tissue hypertrophy. Both of these patients had normal male contours of body with normal genitalia.

The specimen in another patient, Case 4, showed no adipose tissue within the well-encapsulated mass of breast tissue, but there was a slight rim of

FIG. 14.—Adipose tissue brought together with sutures so as to cover the pectoral fascia.

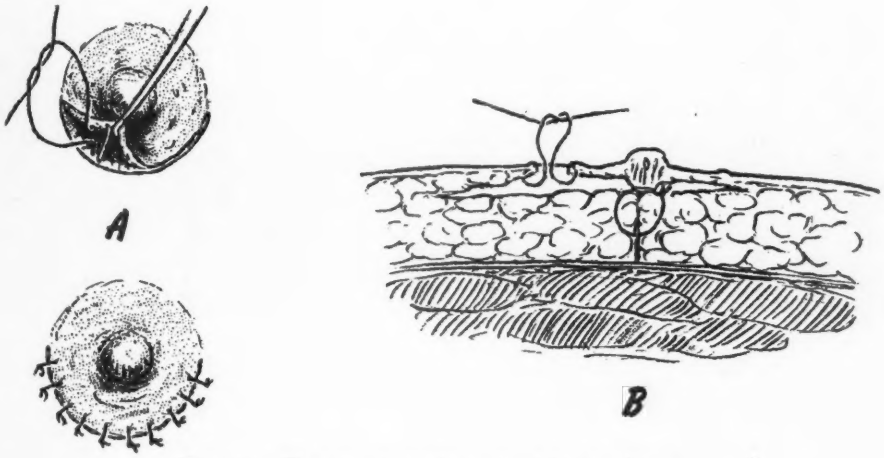


FIG. 15.—Closure of areolar wound in two layers.

adipose tissue at the periphery of the gland. This patient at the age of 12 had had a bilateral herniorrhaphy and operation for left undescended testicle performed at another hospital. Both testicles had atrophied and were barely palpated. The enlargement of the breast began at the age of 19. Subsequently, very extensive hormonal treatment was instituted which brought out secondary sexual characteristics, with the appearance of a beard and hair on the body, particularly after the use of oretone. However, this

treatment failed to reduce the size of the breasts. While under very intensive hormonal treatment there was thought to be some decrease in the size of the breasts, but this was explained by the decrease in the subcutaneous fat everywhere. His original eunuchoid appearance changed under hormonal therapy to normal male type. He was 27 years old when operated upon, having had the condition for eight years.

FIG. 16

FIG. 17

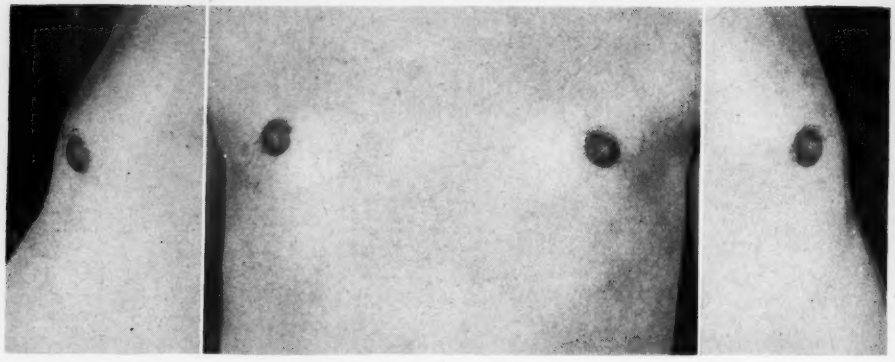


FIG. 16.—Case 1: Condition before operation in a 15-year-old boy with normal male type of body and genitalia. Onset at age of 13. Patient teased a great deal and very sensitive.

FIG. 17.—Case 1 (cont.): Condition seven months after operation showing normal appearance of male pectoral region, areolae, and absence of noticeable scars. Hypertrophy found due entirely to enlarged periductal connective tissue with no adipose tissue present. Patient "not kidded any more."

Three patients, Cases 7, 17 and 10, (Figs. 22 and 23), showed absolutely no mammary tissue in the specimens, the enlargement being entirely due to adipose tissue with moderate fibrous tissue strands. Two of these patients were definitely of the Froehlich type (Cases 7 and 17) with slightly underdeveloped genitala. One patient, Case 10, was mildly obese, very hairy, and had normal genitalia.

The remaining cases were of the intermediary group with both breast tissue and adipose tissue combined in varying proportions.

Ten cases received hormonal therapy in the following amounts: Case 3+, Case 4 ++++, Case 5 ++++, Case 8 +, Case 9 ++++, Case 10 ++++, Case 11 +? (elsewhere), Case 13 + (elsewhere, for undescended testicles), and Case 14 ++++. The remaining patients were not given any endocrine therapy.

FIG. 18

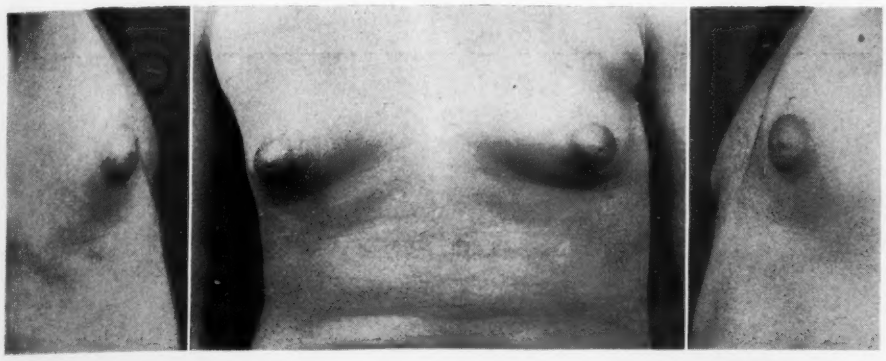


FIG. 19

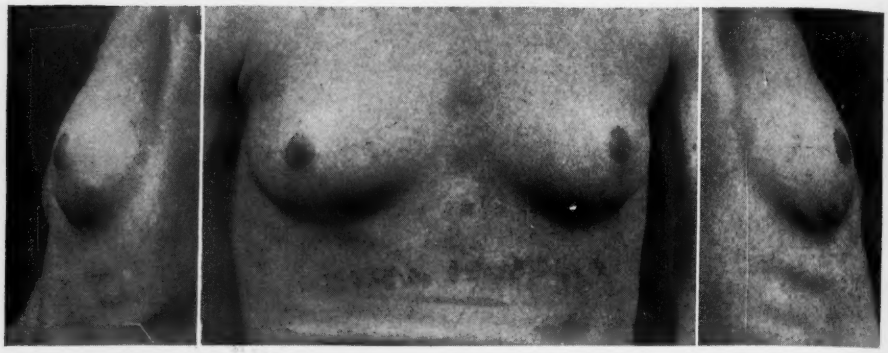
FIG. 18.—Case 9: Preoperative condition in a 14-year-old colored boy with obese feminine type of body, female distribution of pubic hair, and normal male genitalia. Condition began at age of 12. Extensive treatment with testosterone and oretone injected into left breast resulted in no appreciable change in the size of breasts. Patient embarrassed to undress before others.

FIG. 19.—Case 9 (cont.): Condition 16 months later, and five weeks after operation. Breast tissue composed of ducts and ductules, connective tissue and fat, showing fat necrosis with cavitation from oretone pellets. Patient very pleased with result of operation.

In no case was any complaint made of pain in the breasts although one patient recalled having had pain. All 17 patients gave a history of embarrassment because of the condition prior to operation. This was not admitted in one case, Case 6, but the reason he gave for seeking treatment was because "the swimming season was approaching."

One patient, Case 7, (Figs. 22 and 23) repeatedly went home crying because of being teased. In this patient a collection of serosanguineous fluid developed postoperatively in one breast, and this fluid was aspirated on one occasion. This aspiration brought the breast down to normal limits but subsequent thickening persisted. Probably more tissue should have been excised, and operation on this breast will have to be repeated. Nine months

FIG. 20



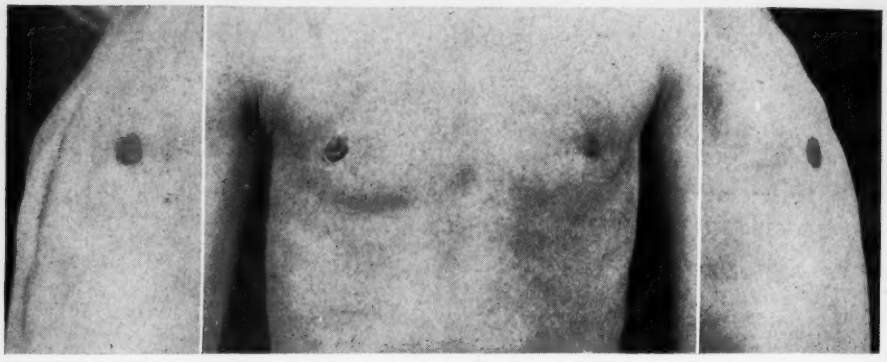


FIG. 21

FIG. 20.—Case 8: Condition before operation in 17-year-old boy with well-developed male type of body. Condition appeared at age of 13. Second degree hypospadias, with good operative correction. Testicles normal size. Two oretone pellets inserted into left breast (note scar) without improvement. Acute embarrassment when undressing in gymnasium.

FIG. 21.—Case 8 (cont.): Condition one month after operation. Specimens showed both periductal connective tissue and adipose tissue hypertrophy. Serosanguineous fluid was aspirated from both breasts on 5th and 7th postoperative days. After operation and changing schools patient had no hesitancy to undress in gymnasium.

after operation this patient was still unwilling to undress before others because of the enlarged left breast.

One patient (Case 14) with a Froehlich's syndrome and an atrophied right testicle and undescended left testicle, in whom the enlargement of the breasts was found to be due almost entirely to adipose tissue, still has some-

what prominent breasts, particularly on the right side. This is noticed especially when standing. This patient is still unwilling to expose his breasts when undressed or in swimming. It is more difficult to know exactly how much adipose tissue to remove in the cases in which enlargement is due to an increase in this tissue than in the cases in which the mammary tissue itself is the predominant cause of the enlargement.

FIG. 22

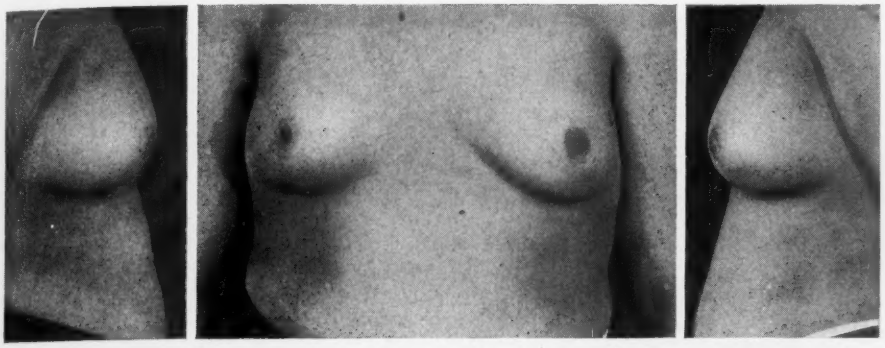


FIG. 23

FIG. 22.—Case 7: Preoperative condition in 15-year-old boy of Froelich type but with normal male genitalia. Onset said to have been at ten years of age. Futile extensive testosterone therapy with repeated injections of oretone into left breast. Breasts large, areolae small. Patient teased unmercifully and frequently "came home crying."

FIG. 23.—Case 7 (cont.): Condition five months after operation. Specimens showed only adipose tissue hypertrophy with no breast tissue or ducts observed. Twenty cubic centimeters of serosanguineous fluid aspirated from left breast on 9th postoperative day. Probably insufficient tissue removed from left breast. Patient dissatisfied with postoperative condition of left breast and was unwilling to undress before others.

Another patient, Case 8, (Figs. 20 and 21) postoperatively developed a collection of serosanguineous fluid in both breasts. Thirty-five cubic centimeters were aspirated from each breast five days after operation, and 20 cc. from the right breast and 10 cc. from the left breast one week after operation. This patient had an excellent final result and his previous embarrassment when undressing for gymnasium classes was completely eliminated.

Case 11 represents an unsatisfactory result. The operation was performed by two residents on the author's service. This patient was a case of true eunuchism, with no testicular remnant recognizable. His breasts had started enlarging at the age of 13, and his body weight increased until he weighed 260 pounds six months before he was seen in the Plastic Surgery Clinic. By dieting he lost 60 pounds. Both breasts were large, the left

FIG. 24

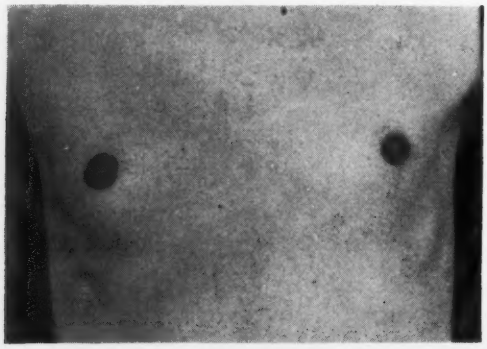


FIG. 25

FIG. 24.—Case 12: Unilateral right gynecomastia in 27-year-old man with normal male type of body and genitalia. Areolae and nipples dark and minutely papillomatous. Condition began at age of 16. No preoperative hormonal treatment. No marked complex before operation but "has feeling of guilt."

FIG. 25.—Case 12 (cont.): Postoperative condition seven months after operation. Specimen showed hypertrophy of numerous ducts, connective and adipose tissue. Patient wears trunks and goes swimming without qualms.

being pendulous and shaped like that of an adult female. When the specimen was examined microscopically the hypertrophy was found to consist almost entirely of fat with some connective tissue present. No ducts were observed. The specimen from the left breast weighed 450 gm., and measured 14 x 13 x 4 cm., while that from the right breast weighed 430 gm., and measured 15 x 10 x 4 cm. These represented the largest amounts of tissue removed from any patient in this series. Drainage was instituted at operation

through the right areolar incision, this being the only patient in the series who was drained. On the 9th and 12th postoperative days, respectively, 98 cc. and 35 cc. of serosanguineous fluid was aspirated from the left breast, and there was early serosanguineous discharge from the drainage wound in the right breast. There was necrosis of approximately one-third of the entire right areola and one-half of the left areola, apparently due to redundancy of the tissue with folding-in of the areola and the application of a very tight pressure dressing. The wounds did not heal until 82 days after operation. The excessive volume of the breasts was reduced but the nipples were definitely deformed. The patient did not return to the clinic after the wounds healed, as he was apparently drafted into the Army. The results in this case were far from ideal because of the deformity of the nipples. It was, however, more satisfactory than some cases reported in the literature.

Another patient, Case 16, recently operated upon, had very superficial necrosis of both areolar flaps and 15 cc. or less of serosanguineous fluid was aspirated from the left breast on three occasions. It was thought that the cause of the superficial necrosis was the application of an excessively tight bandage. The final appearance was excellent.

There was no infection in any of the breasts operated upon in the series, with the exception of the surface suppuration of the necrotic areolae in Case 11.

Dr. Thomas W. Stevenson operated upon the opposite side from the author in Cases 1 and 2. He was the attending surgeon in charge of Cases 3, 5, and 6 and took part in the operations in Cases 3 and 6.

SUMMARY

1. The indications for corrective therapy for gynecomastia are discussed with emphasis on the importance of overcoming the psychic trauma caused by the female appearance of the male breast.
2. Of the various therapeutic measures that have been advocated, operation offers the most satisfactory result.
3. Extra-areolar incisions for removal of breast tissue leave scar deformities that indicate operative interference; therefore, such procedures fail to attain the best psychologic results.
4. A mastectomy operation through a semicircular intra-areolar incision is here presented by which the excess breast tissue is removed leaving a practically invisible scar.
5. Over a period of 12 years, 17 patients requiring 32 mastectomies have been operated upon by this method, with almost uniformly excellent results; and the preoperative complexes have been overcome in nearly all cases.

CONCLUSIONS

Mastectomy through a semicircular intra-areolar incision for the correction of gynecomastia is a procedure which offers many advantages over

operation with other types of incision. The results of this procedure on 32 breasts were almost uniformly excellent, the insufficient reduction in the size of the breasts in Cases 7 and 14 and the deformities of the nipples from necrosis in Case 11 being the only exceptions. The final appearance in all cases may be favorably compared with the results obtained by other procedures. The absence of noticeable scars such as occur with extra-areolar incisions, together with the reduction of the breasts to normal size and contour, removes the cause of the patient's psychic disturbance. Since the normal appearance of the male pectoral region is achieved by this operation with almost no evidence of operative interference, the patient can indulge in normal activities and expose his chest without fear of ridicule or need of explanation.

The operation requires careful technic and meticulous hemostasis, together with considerable skill, judgment, and patience on the part of the operator to remove a proper amount of tissue along optimum planes and to close the wound satisfactorily in the depths as well as on the surface. It is felt, however, that this type of operation, which leaves inconspicuous scars, should be employed when mastectomy for gynecomastia is to be performed.*

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* This operation has been performed once upon a 14-year-old colored patient with true hermaphroditism.[20] The breasts were similar in size and shape to those of a 16-year-old girl but the patient desired to live as a man. A slight excess of tissue was left on one side.

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SUBTROCHANTERIC OSTEOTOMY FOR UNUNITED FRACTURE NECK OF THE FEMUR*

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ALTHOUGH, since the advent of internal fixation after fracture of the neck of the femur by various forms of nails and screws there has been a slight increase in the percentage of patients thus injured who regained ambulation, ununited fractures of the neck of the femur still occur. Many of these have been inefficiently treated by forms of traction, either in bed or ambulatory, and a few have been victims of improper or inefficiently accomplished internal fixation by various devices.

In my presidential address before the Western Surgical Association, 1928, attention was called to the length of time required for bony union after complete reduction and treatment of fracture of the neck of the femur. Instances were cited, and illustrated, in which this healing required six months, or more, time and the criteria of healing furnished by the restoration of full trabecularization across the fracture plane shown in the roentgenologic control was first brought out. Too early weight-bearing after recent fracture of the neck of the femur, no matter how treated, is a sad mistake because although it *may* not cause secondary displacement of the fracture, the pressure against the still partly devascularized head and imperfectly healed neck (trabeculae not permanently formed) must provoke degenerative change in the cartilage and bone.

Stress on the fractured neck of the femur incidental to shearing and adduction strain may be measured in degree by the obliquity of the fracture plane to the horizontal. This was first brought out by Pauwel, and was widely recognized in the surgical world. To this obliquity must be added, as of equal importance, the rotatory force, usually turning the leg outward, which causes a separation of the fracture surfaces of the neck, which, if uncorrected, leaves a V-shaped bony defect usually on the posterior aspect of the neck. Whitman tried to overcome this in his abduction treatment.

A horizontal plane may be indicated by a line drawn through both anterosuperior spines of the ilium on the anteroposterior roentgenogram including both hips with the patient lying fully straightened out. By adding a line through the fracture plane of the neck of the femur extended to meet the horizontal line, an angle is formed of various widths depending on the obliquity of the fracture. King advised that three grades of fracture may be recognized.

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* Read before the Western Surgical Association Chicago Meeting, November 30, 1945.

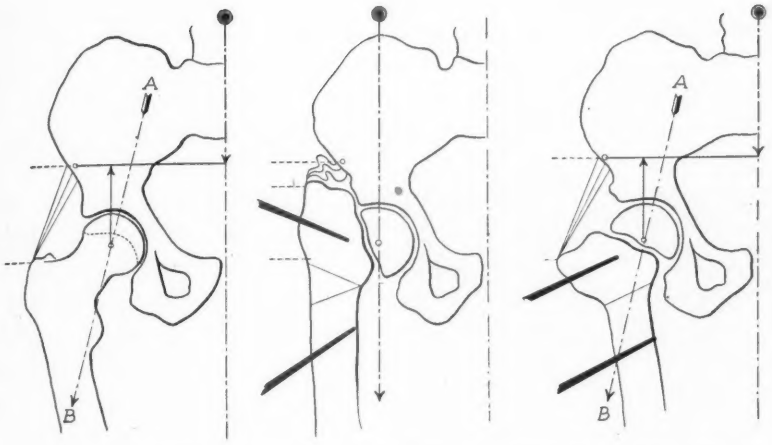

FIG. 1.—Pauwel's method of cuneiform osteotomy to correct ununited fractures neck of the femur. (From Hillebrand's article on the "Treatment of Pseudarthrosis of the Neck of the Femur." Bruns Beit. z. Klin. Chir., **157**, 281, March, 1933.)

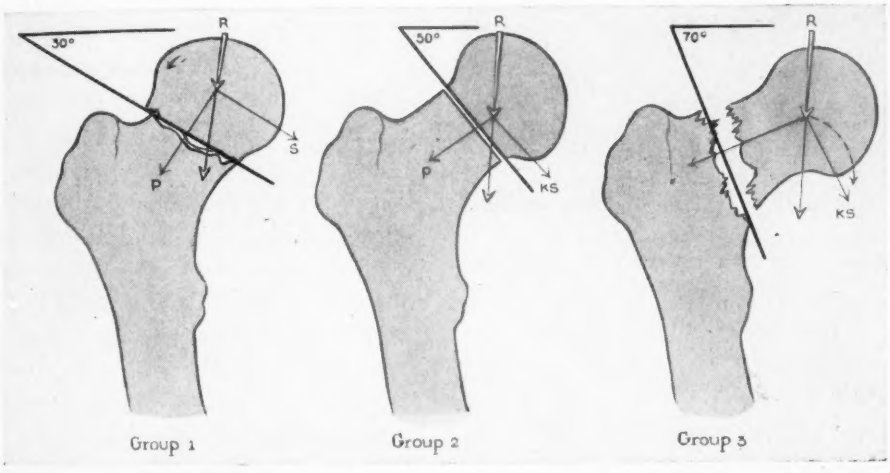

FIG. 2.—Modified from King's description of the angles formed between a horizontal and various fractures of the neck of the femur.

Group 1: Thirty degrees, or less, not requiring internal fixation when properly reduced and immobilized.

Groups 2 and 3: Requiring firm internal fixation as the angle of the fractures increased over 30 degrees with a horizontal line through the pelvis increasing the shearing stress and lessening the chance of holding reductions. (King, Thomas, Brit. J. Surg., **26**, 721, April, 1939.)

Group 1.—A truly impacted or abduction fracture in a position of coxa valga, in which the angle between these two lines is from 30 to zero degrees. The fracture surfaces are nearly horizontal. Osseous union after immobilization almost invariably follows because no shearing force due to muscle action or weight-bearing exists. No operation for internal fixation is called for, according to King. In some of these instances (impacted) the patient may have walked, albeit with pain and limp, for some time before fracture was recognized, disimpaction fortunately not having occurred.

FIG. 3.—Insertion of marker about two inches below the tip of the greater trochanter of the femur after reduction of the ununited fracture of the neck, patient lying on the fracture table, leg fixed by skeletal traction through the heel. The transverse and obliquely upward osteotomy is performed with this guide for location.

Group 2.—The fracture plane in the neck forms an angle of 30°–50° with the horizontal. In this group transfixion by nail, screw or bone transplant is indicated, not only to hold the fragments together or to prevent their rotation from uncorrected eversion of the foot but to prevent the untoward action of the shearing force mentioned.

Group 3.—The fracture plane forms an angle of 50° plus up to 90°, or vertical in type. These require secure internal fixation after complete reduction to cover the points mentioned. For these extreme instances of vertical fracture, or separation, King uses both a nail in the lower third of the reduced neck to protect against rotation and lateral separation of the fracture surfaces and also a full-thickness fibular graft above the nail to fit tightly into the head of the femur to prevent tilting of the head and resulting coxa vara. This fibular graft may also supply an osteogenetic stimulus, hopefully leading to prompt bony union.

In old ununited fractures the fracture plane has become almost vertical due to absorption of the lower part of the neck and rise of the trochanters — it may be classified with Group 3. To assist these unfortunates, many of whom are elderly and yet not completely discarded individuals, who have agility and mental powers which may still make them worth while, osteotomy just below the neck of the femur has offered unbelievable hope of restoration of ambulation, with some restrictions.

Subtrochanteric osteotomy aims to alleviate pain in the hip, to restore bony union, of a sort, and consequently assist, or render possible, weight-bearing and ambulation, with restoration of the individual's freedom of action and usefulness. The operation itself is done quickly, it involves little shock and brief anesthesia, its results are often beyond expectation. It is usually reserved for patients 60 or more years old.

The cause of the nonunion excluding septic infection (usually from an operation) or aseptic necrosis of the head from interfered with blood supply, usually beyond the surgeon's control, can not fully be discussed here. Subtrochanteric osteotomy may be used to treat older people, or those whose fracture has been neglected or poorly treated for a longer period of time

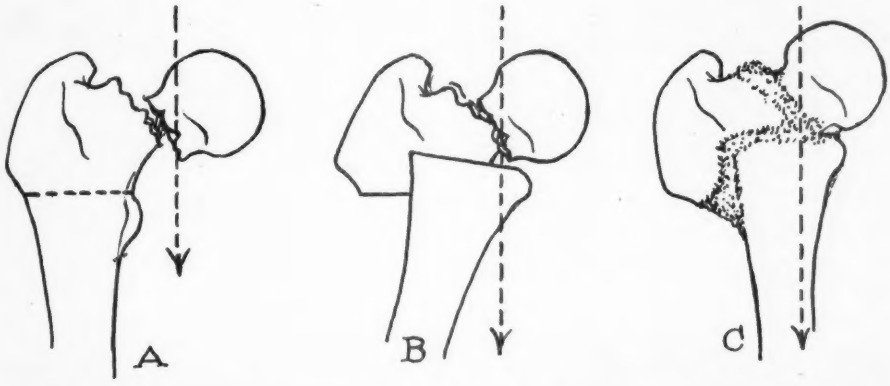

FIG. 4.—Diagrammatic representation of the subtrochanteric osteotomy:
(A) The line of osteotomy is too straight and should be directed diagonally upward.
(B) The shaft fragment is pushed in and
(C) A healing process has occurred not only to the trochanter but to the neck with the weight-bearing line now passing through the head of the femur directly into the shaft as indicated. (From the Author's text on Fractures and Dislocations, Lea and Febiger, Philadelphia.)

than is usually accepted as the clinical limit for more complicated surgical methods, such as bone grafts or reconstruction operations. I wish to review briefly the mechanics, pathology, technic, after-treatment and results of subtrochanteric osteotomy.

Ununited fracture may result from primary lack of diagnosis; incomplete or no roentgenogram from the extreme obliquity of the fracture of the neck which inhabits firm and holding apposition of fragments; improper or incomplete reduction; too short a period or too weak traction, if used, and improper and inefficient internal fixation, if attempted. The last named method is still further jeopardized by a belief that the patient may walk on the nailed, or screwed, neck of the femur in a few days. In the face of an

FIG. 5.—Ununited fracture neck of the femur of nine months standing.

oblique angle of more than 30° was described, he can not safely and universally do so. He usually requires a bony union before ambulation with weight-bearing should be attempted—an average of six months' time. If he bears weight before that period of time, the natural obliquity of the angle of the neck of the femur, enhanced by the additional obliquity of the fracture plane, is bound to result in coxa vara restricted and painful motion; leg shortening; foot eversion; and often hip joint pain and ultimately breaking down of the head with proliferative arthritis of the hip joint.

Before determining the advisability of subtrochanteric osteotomy the following requirements must be met:

1. All tractions or splints and fixations (including internal fixation) must be removed.
2. Open ulcers, or decubitus, near the fracture area must be healed.

FIG. 6.—Same hip compared to normal, nine months after subtrochanteric osteotomy. Note the union between head and shaft; the obliquity of the osteotomy; and the healing of the trochanteric portion in good position. There was practically no change in the length of the limb, and the patient walks bearing full weight without pain. Head of the femur as yet shows no evidence of necrosis or breaking down.

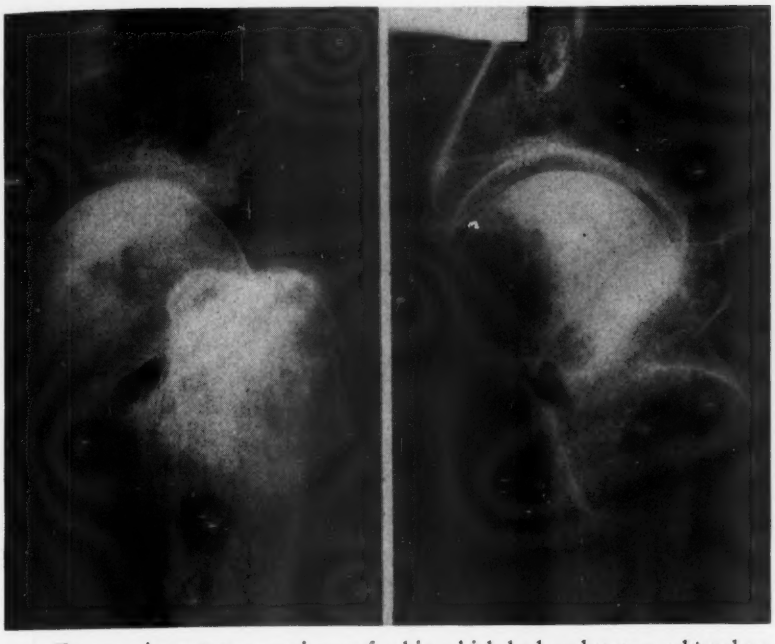

FIG. 7.—An autopsy specimen of a hip which had undergone subtrochanteric osteotomy 9.5 weeks previously. The roentgenogram already shows healing of the trochanteric portion, but as yet an incomplete bony healing to the head. Patient passed away from an embolism when he was becoming ambulatory.

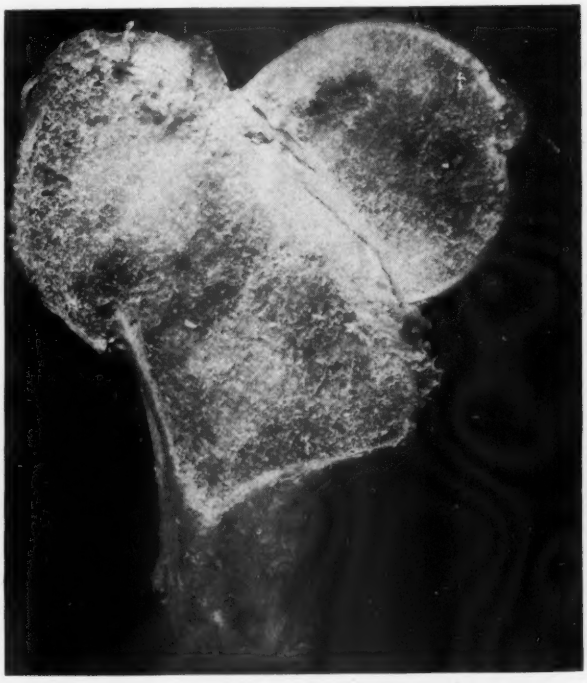

FIG. 8.—Photograph of section through the specimen shown in Figure 7. The healing of trochanteric fragments seems quite complete. The head and neck although not bonily united are firmly apposed, and gave promise of bony union in the not distant future, aided by proper weight-bearing.

3. Roentgenologic examination of both hips in a postero-anterior plane and a lateral of the fractured hip must be obtained to determine:
   (a) The amount of absorption of the neck,
   (b) The presence or absence of infection or sequestra or ankylosed joint,
   (c) The rotation of the head fragment,
   (d) The viability of the head determined by its relative density.

If these factors are unfavorable, if the head is completely necrotic, one of the reconstruction operations on the hip may be the best procedure, especially in patients under 60 years of age. Although union to a dead head might be obtained by osteotomy, it would take, at best, a long time to establish revitalization and bone substitution of the head. This might never follow and thus lead to crushing down of the head with all its sequences after weight-bearing was allowed. The patient might not survive the long drawn-out process of rebuilding the head of the femur, and so derive no benefit from the procedure.

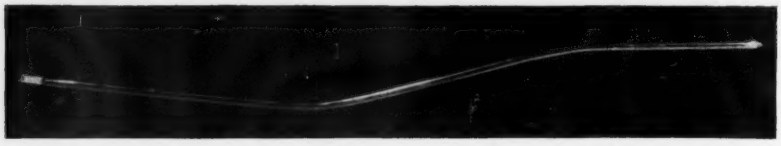

FIG. 9.—Shows the deformation of the Steinmann pin through the heel in another instance permitting the shaft of the femur to slacken inside the encasement, and thus change the position obtained at the osteotomy eight weeks before. A final bony healing occurred, but with restricted range of motion, without pain. The pin used for the traction and fixation should be sturdy and strong enough to obviate such deformity while undergoing the strain within the plaster support.

If these briefly mentioned conditions are favorable, the patient's general condition unless obviously moribund, the fear of expected follow up care, his age, and even his weight, may be discounted. Preliminary traction on the leg by means of a sturdy steel pin inserted through the calcaneus may be helpful in marked overriding of the fracture of the neck. At operation, manipulation on a fracture table with perineal post and foot pieces for traction, is performed to put the fragments of the ununited neck into apposition and to hold them thus with slight abduction of the legs — 15°–20° as a rule. This is securely held by means of fixed traction to the foot pieces of the fracture table, using the skeletal traction on the injured side, with the toes straight up or even slightly inverted. The reduction thus obtained at the neck of the femur is checked by roentgenograms in two axes, anteroposterior and lateral.

A short incision 3 to 4.5 inches long is made on the lateral surface of the injured hip, starting at the greater trochanter, passing down directly in the long axis of the femur. The skin, fat, fascia and thin muscle layer are cut through. The upper end of the femur is exposed and a point selected about

two inches below the tip of the greater trochanter. Into the cortex of the femur, at this point, a steel marker—a pointed wire or Steinmann pin—is inserted at right angles to the long axis of the bone. Another antero-posterior roentgenogram is made to determine the position of this marker in relation to the lesser trochanter of the femur. If it is placed at a satisfactory level so that the osteotomy near it will cut through the trochanteric portion of the bone just above the lesser trochanter, a broad-bladed chisel is then driven through the femur with a heavy hammer in a slightly oblique upward direction. This cuts the shaft of the bone completely free from the head and trochanter and yet the shaft lies in traction and in slight abduction in relation to the long axis of the body. The shaft fragment is then shoved inward through the small wound as far as it will go or the whole thigh can be bumped in by the operator's body-weight, the leg traction remaining firm. A roentgenogram is made to confirm this inward displacement of the shaft almost directly under the head of the femur and the wound is closed in layers.

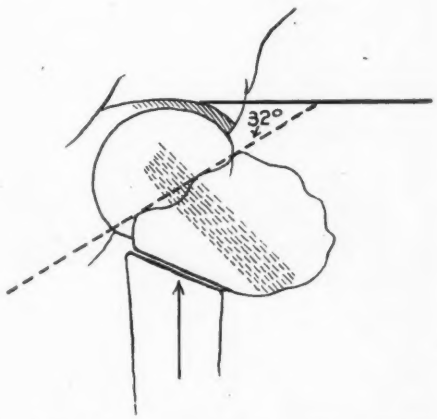

FIG. 10.—King's method of fixation by bone transplant introduced through the neck into the head followed by the osteotomy. This aims to prevent a slipping out of the shaft fragment and a better retention of the trochanteric fragment. The result of this step is doubtful in my mind as the healing between the head and trochanteric portion depends solely upon the bone transplant.

A light plaster-of-paris encasement is then applied enclosing the whole operated upon leg and firmly pressing against the skeletal traction in the heel embracing also the good leg almost to the knee, which is left free. The time of the operation is short, cooperation of the roentgenological work expedites it.

Eight weeks immobilization during which the patient is turned onto a prone position twice a day suffices for union, not only of the osteotomy but quite marvelously of the ununited neck. The bone has been restored to a weight-bearing axis and healing thus favored—a seemingly simple solution.

One may use pins, such as the Neufeld, Preston or Austin Moore pin, and others, which pass through the neck and head with an angled extension screwed onto the shaft to hold this inwardly placed shaft of the femur. I have found them unnecessary. For osteosynethesis King[1] used a pin and fibular transplant through the trochanter into the neck and head to hold these fragments together before performing the osteotomy. This is very useful to prevent slipping up of the shaft. I cannot find, even in the oldest patient, that the eight weeks splintage acts untowardly if proper nursing care is given. This care must be first class and planned before operation. Pin deformation (through the calcaneus) accounted for the only instance of

mechanical failure I have encountered. The attempt on this patient, consequently, did not result in the ideal length and use of the hip joint. The transfixion pin for the skeletal traction through the heel must be strong enough to stand the traction strain of holding the leg in full length during the operation and thereafter until bone healing appears. After the pull of the fixed traction on the table is relaxed following operation, this stress is taken up by the plaster dressing pressing against the pin, with counter pressure up on the head of the tibia and the pelvis above. It must maintain the

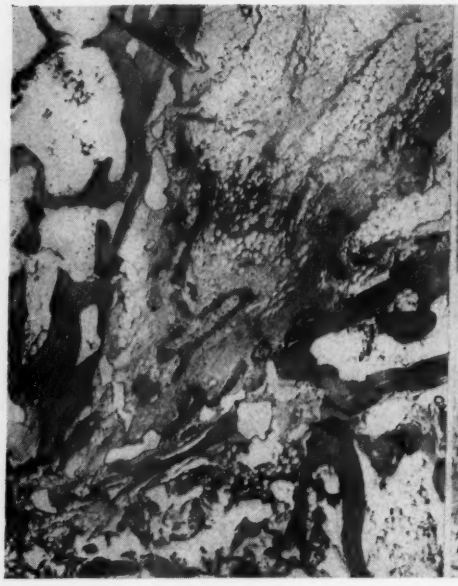

FIG. 11

FIG. 12

FIG. 11.—Healing of the trochanteric portion of the femur to the shaft after 9.5 weeks. About six diameters magnification. The formation of new bone between the two bony surfaces is apparent.

FIG. 12.—Beginning healing after 9.5 weeks between the surface of the subtrochanteric osteotomy and the head of the femur. Some of the osteoid tissue has washed out in making the section, but the effort at bony union is starting and the vascularity promised final body union.

pressure which is augmented soon by the pull, inside the plaster, of the muscles from torso to thigh, or even leg, which becomes a very powerful traction. If the shaft fragment tends to slip up and outwards, the axis of its application to the head and neck of the femur is changed, and the hoped for result may be a partial failure. Such a hip, however, may obtain bony union, become painless and permit weight-bearing, but with greatly restricted range of motion.

As a rule, astonishingly enough, the incisions and fractures heal even in the aged. After subtrochanteric osteotomy the hip, though somewhat restricted in all motions, soon bears weight and resumes pleasing function.

The knee stiffness incidental to plaster confinement gradually wears off under physiotherapy, and the patient proceeds to stable ambulation.

One fatality in ten patients, varying in age from 62 to 78 years, operated upon in this, and other hospitals, has occurred. Death resulted from pulmonary embolism in the tenth week after operation, as the man was about ready to leave the hospital. The remaining nine patients are ambulatory, some with, some without canes, no hip pain, a slight amount of shortening of the injured leg. No patient has yet shown necrosis or breaking down of the head of the femur, possibly because not more than three years has elapsed for any one of them. Following their ununited fracture of the neck of the femur, they have been restored from a threatened invalidism to activity.

REFERENCES

[1] King, Thos.: Closed Operation for Intracapsular Fracture Neck of the Femur. Brit. J. Surg., **26**, 921, 1939.

INCISIONS IN SURGERY OF ANEURYSMS

WITH SPECIAL REFERENCE TO EXPLORATION IN THE ANTICUBITAL AND POPLITEAL FOSSAE

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IN THE SURGERY OF ANEURYSMS and other lesions of arteries it is important that one use an incision which permits easy and complete access to the vessels involved. Furthermore, it is important that the incision be so placed that, by lengthening it, the vessels distal and proximal to the site of suspected pathology are accessible without difficulty. These considerations do not obviate in any sense, however, the advisability of using skin incisions which yield a good plastic result, which do not cross normal skin folds, and which minimize the hazard of keloid formation, scarring and contracture, provided that such incisions sacrifice nothing essential in regard to exposure of the vessels. In my experience with the operative treatment of over 260 aneurysms and arteriovenous fistulae, rarely, if ever, have I found that a properly placed plastic incision offers any real limitation in exposure of the vessels. It is the purpose of this communication to discuss this general problem and particularly that of exploration in the popliteal fossa and in the anticubital space.

THE POPLITEAL FOSSA

It has been common practice to explore the popliteal vessels through a longitudinal incision which crosses the popliteal crease. A high percentage of patients who have been subjected to such an incision subsequently develop heavy scars or keloids, contracture, and, in some instances, ulceration. This sequela is disabling and its remedy by plastic procedures is time-consuming and not always successful. Such incisions are, I believe, entirely unnecessary in exposing the popliteal vessels.

For lesions of the femoropopliteal and first portion of the popliteal vessels, a longitudinal anteromesial incision extending down to the knee is used. When the thigh is externally rotated and the knee is flexed, the sartorius is relaxed and easily retracted. The femoral vessels are accessible proximal to the point where they pass under the adductor tendon and the popliteal vessels where they emerge beneath this tendon. Exposure of the popliteal vessels by this incision is illustrated in Figure 1.

When the lesion exists more distally, one of the incisions illustrated in Figure 2 is employed. The essential feature here is a transverse incision across the popliteal space in one of the popliteal creases. Indeed, a simple transverse incision will occasionally suffice, particularly when a large saccular aneurysm is approached by the intrasaccular route under tourniquet. Generally, however, the incision must be extended upward along the mesial aspect

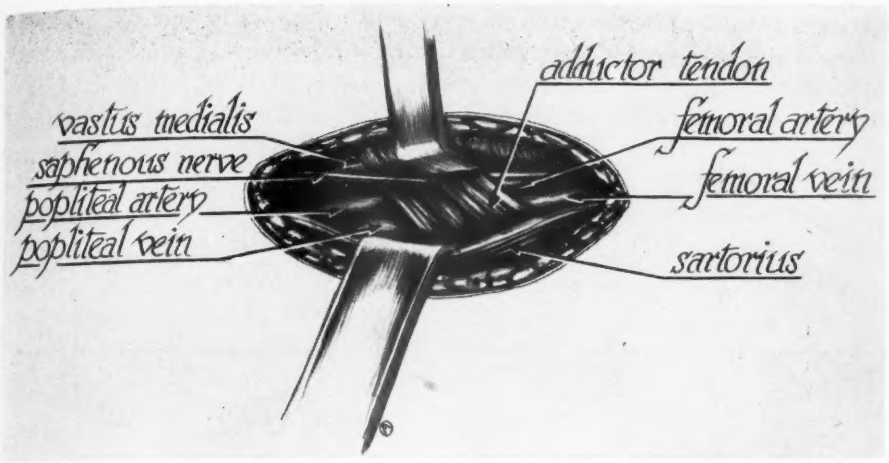

FIG. 1.—Exposure of the distal portion of the femoral and the first portion of the popliteal vessels.

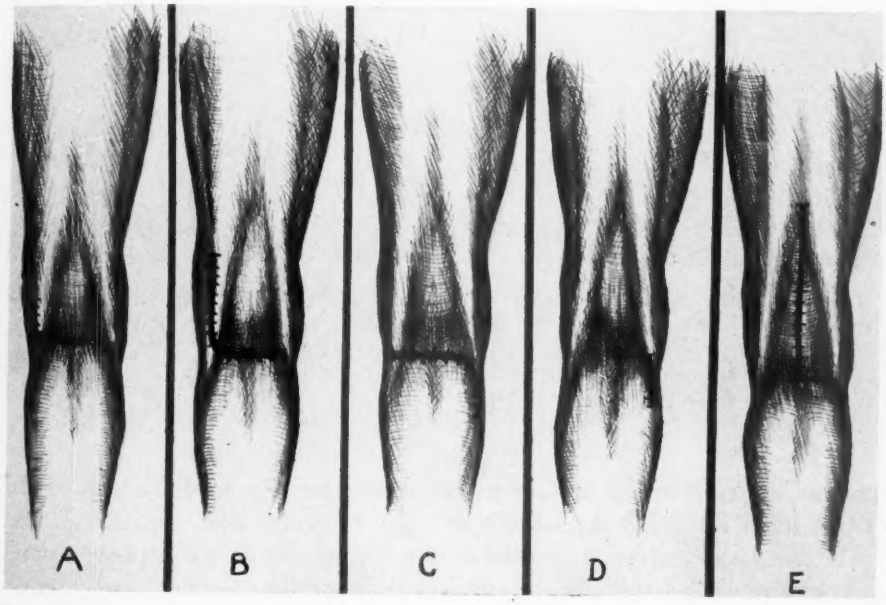

FIG. 2.—Skin incisions used in exploring the popliteal vessels:

(A) The incision used when the lesion exists in the popliteal vessels in the mid-popliteal space.
(B) The incision used when the lesion is higher in the popliteal fossa.
(C and D) Incisions used for exploring the distal popliteal vessels.
(E) A modified incision useful when associated nerve lesion requires exploration.

of the thigh and downward along the lateral surface of the leg (Figs. 2A and 3A). The resulting exposure is quite as good, perhaps better, than with the use of a midline longitudinal incision. The skin flaps are reflected and the fascia is incised longitudinally in the midline. The biceps is retracted laterally; the semimembranosus and semitendinosus mesially. The tibial and peroneal nerves are identified without difficulty. The vein and the artery are accessible. The exposure obtained is illustrated in Figure 4. If the lesion is high in the popliteal space, an L-shaped incision extending across the popliteal space and up along the mesial aspect of the thigh is sufficient (Figs. 2B and 3B). If there is an accompanying nerve lesion which requires surgery this procedure is facilitated if the longitudinal limb of the

A B C

FIG. 3.—Photographs of wounds in popliteal space:

(A) Arterial aneurysm in midpopliteal fossa was excised.
(B) Arteriovenous fistula just proximal to midpopliteal space was excised. Often the upper limb of incision must be extended farther up the thigh.
(C) Arteriovenous fistula of distal portion of popliteal vessels was excised.

incision is placed in the midline rather than along the mesial aspect of the thigh (Fig. 2E).

If the aneurysm or fistula is in the distal portion of popliteal space, exposure is difficult by retraction or division of the heads of the gastrocnemius muscle and such a procedure entails a definite hazard since the tibial innervation of the gastrocnemius, the plantaris and popliteus muscles may be injured. Exploration is made easy by using an L-shaped incision which crosses the lateral half of the popliteal space and extends downward along the posterolateral aspect of the calf (Figs. 2C, 2D and 3C). The fascia is divided beneath the skin incision. The lateral head of the gastroc-

nemius, along with the plantaris, is easily elevated and retracted upward and mesially. The popliteal artery and vein and the tibial nerve are then brought into view and can be followed as they cross over the popliteus muscle and pass through the tendonous arch of the soleus muscle (Fig. 5). If the lesion exists in that portion of the vessels covered by the soleus muscle, the skin incision must be extended down the leg. Exposure of the

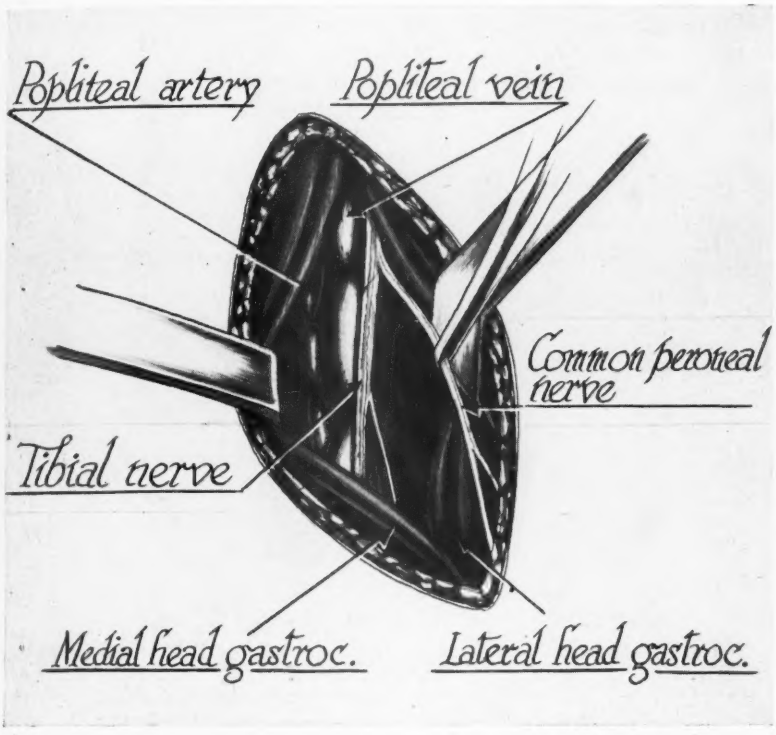

FIG. 4.—Exposure of the popliteal vessels in the popliteal fossa. The biceps muscle is retracted laterally above and the plantaris and lateral head of gastrocnemius below. The semimembranosus and semitendinosus are retracted mesially above and mesial head of gastrocnemius below. Tibial and common peroneal nerves are isolated and protected. Ligatures are illustrated about the artery and vein proximal and distal to the fistula.

vessels generally necessitates division of the lateral fibers of the soleus attached to the fibula, with or without division of that portion arising from the head of the fibula. Sometimes the vessels can be exposed satisfactorily by incising the muscle longitudinally directly over the vessels.

Incisions such as have been described have been found to be perfectly adequate, and good healing without scarring or contracture has been obtained in all cases. The incision for exposure of the femoropopliteal or proximal popliteal vessels has been used in 24 cases. The various modifications for exposure of the vessels in the popliteal space itself have been

used in approaching 25 aneurysms and also in one case of hemangioma. Aneurysms of the distal portion of the popliteal vessels have been approached through the incision described in 17 cases. In all instances proper surgical treatment of the aneurysm has been carried out without difficulty.

THE ANTICUBITAL FOSSA

The brachial vessels through most of the length of the arm are easily approached through longitudinal incisions overlying their course, and such incisions are entirely satisfactory. For operations upon the first portion of the brachial vessels, an incision which does not cross the axilla will be described subsequently. For lesions in or near the anticubital fossa it has

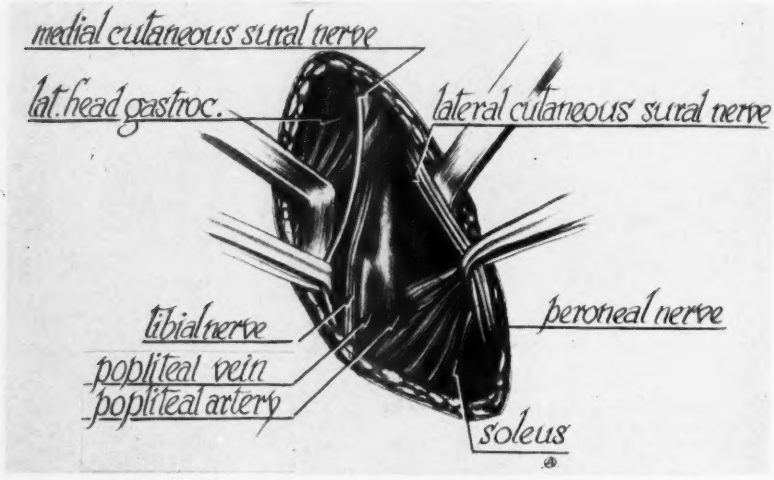

FIG. 5.—Illustration of operative exposure of distal portion of popliteal vessels. Lateral head of gastrocnemius is retracted and vessels and nerve are seen lying upon popliteus muscle and as they enter soleus.

been found very helpful to use incisions similar to those employed in the popliteal fossa. A transverse incision is made across this space following a natural skin crease. It is generally extended upward for a short distance along the anteromesial aspect of the arm and downward along the anterolateral aspect of the forearm (Figs. 6A and 7A). The skin flaps are reflected. The communications between the cephalic and basillic veins are divided. The lacertus fibrosus is severed. The cephalic vein and the lateral antibrachial cutaneus nerve are retracted laterally and the basillic vein and medial antibrachial cutaneus nerve mesially. The brachial artery and vein, as well as the median nerve, then come into full view (Fig. 8). The vessels are easily exposed down to a point below the bifurcation into radial and ulnar branches. If the lesion is high, only a transverse incision extended upward is necessary (Figs. 6C and 7B) and if it is low, a transverse incision extending downward may suffice (Fig. 6D). If the fistula or aneurysm

is suspected to exist in the upper portion of the ulnar vessels, a transverse incision is made across the anticubital space and extended downward along the mesial aspect of the forearm (Figs. 6B and 7C). If a lesion exists in the proximal portion of the radial vessels, it is sometimes helpful to supplement an anterolateral longitudinal incision by curving it across a portion of the anticubital space. Such incisions have been used in the exposure of 11 aneurysms. They have proved entirely satisfactory. Prompt healing occurred in all and in none has there been any scarring or contracture. In a single instance, where the corner of an L-shaped incision was perhaps traumatized at operation, a superficial slough about 1 cm. in diameter occurred, but this did not involve the entire thickness of the skin and epithelized readily.

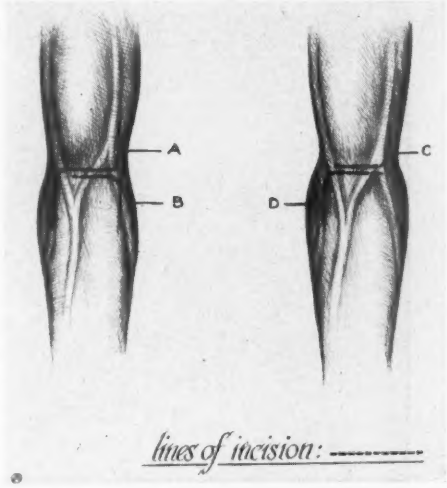

FIG. 6.—Incisions used in exposure of vessels in anticubital fossa:

(A) The usual incision for exposure of brachial vessels in anticubital space.
(B) Incision used when lesion is suspected in proximal portion of ulnar vessels.
(C) Incision used when brachial vessels are involved just proximal to anticubital crease.
(D) Incision used for exploration of distal end of brachial or proximal end of radial vessels.

THE VESSELS IN THE NECK

Many have felt that exploration of the great vessels of the neck necessitated a longitudinal incision along the course of these vessels. It is well known, however, that such incisions yield scars which are often far from pleasing. Heavy and wide scars, keloid formation, and actual contracture sometimes follow. On the other hand, it has been the general experience that oblique skin incisions following the natural skin creases of the neck result in inconspicuous scars which never cause contractures or deformity. Such incisions properly placed are compatible with perfectly adequate exposure of the carotid artery and the jugular vein. During 16 explorations of these vessels I have found such incisions perfectly satisfactory and have used them invariably except in instances when adequate exposure could be obtained by excision of some preëxisting scar (Fig. 9). One can almost always localize the level of the arteriovenous fistula or aneurysm prior to exploration. If one places the skin incision properly and mobilizes freely the upper and lower flaps, the fascia can be incised along the anterior border of the sternocleidomastoid which is retracted posteriorly, the carotid sheath opened longitudinally, and the vessels exposed adequately above, below, and at the site of the pathology. The vagus nerve can be visualized without difficulty and injury to it avoided.

In three of the four vertebral arteriovenous fistulae which I have treated surgically, scars were present and were excised and modified as the situation demanded. In a single instance of a fistula in the first portion of the vertebral vessels exposure was adequate through a low oblique incision in a skin crease. The localization of arteriovenous fistula and other lesions

FIG. 7.—Photographs of wounds in anticubital space:

(A) Aneurysm was excised from midportion of anticubital fossa.
(B) Brachial aneurysm just proximal to midanticubital space was excised. Artery was repaired by end-to-end suture.
(C) Arteriovenous fistula at bifurcation of brachial vessels was excised.

of these vessels is exceedingly difficult since one cannot possibly occlude the vessels by digital pressure throughout that portion which lies within or distal to the tranverse foramina. Furthermore, in any operation upon the vertebral vessels, it may prove necessary to expose them both proximally and distally to the intraforaminal portion.

If the lesion is in the very first portion of the vertebral vessels a low oblique incision, permitting resection of the inner third of the clavicle and mobilization of the subclavian vessels if necessary, is perfectly satisfactory. It would be my feeling that a properly placed oblique incision would prove adequate for lesions of the proximal intraforaminal portion of the vessels. Should a situation arise where it is necessary to expose the vertebral vessels between the atlas and the second vertebra, an additional incision could be used. For lesions in the distal part of the cervical portion of the vertebral vessels, where it will be necessary to have wide exposure and to reflect the insertion of the sternocleidomastoid, it may be preferable to use a more or

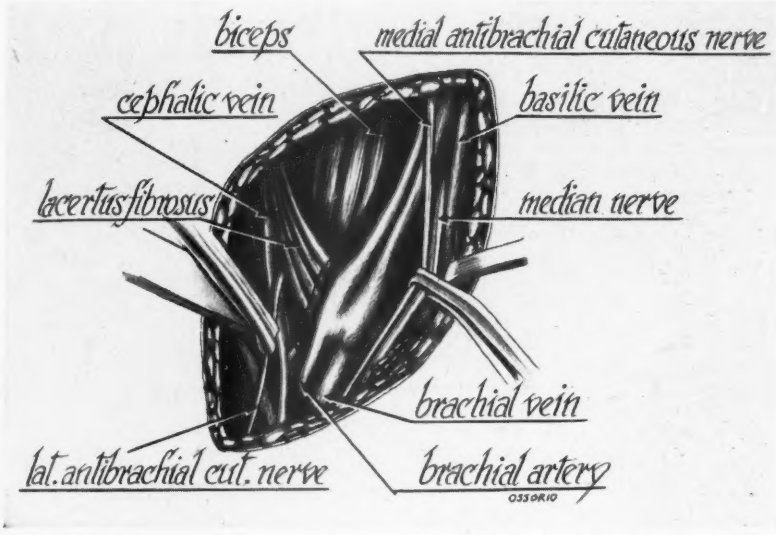

FIG. 8.—Operative exposure of brachial vessels in anticubital space. The communications between basilic and cephalic veins have been divided. Lacertus fibrosus has been severed. The cutaneous nerves and the median nerve are illustrated. A fistula between the brachial artery and vein is shown.

less longitudinal incision. As stated above, my own personal experience is limited to a single instance of a fistula in the first portion of the vertebral vessels, and to three arteriovenous fistulae which were situated in the sixth transverse foramen in which prior exploration had been carried out so that the existing scars were used.

THE INNOMINATE, SUBCLAVIAN, AXILLARY, AND THE FIRST PORTION OF THE BRACHIAL VESSELS

In exploration of lesions of the innominate and of the proximal portions of the subclavian vessels, the author uses an incision which lies over the inner third of the clavicle and curves downward over the center of the upper portion of the sternum (Fig. 10). When the skin flaps are reflected,

there is ready access to the clavicle, the manubrium, the sternum, and the muscles which are attached to these structures. The inner third of the clavicle is resected subperiosteally, the sternum is divided in the midline down to the level of the second interspace and is transected across at this level. The sternum can then be spread with traction upon bone hooks, or with a rib spreader, and good visualization of the vessels is obtained. The skin incisions give excellent scars.

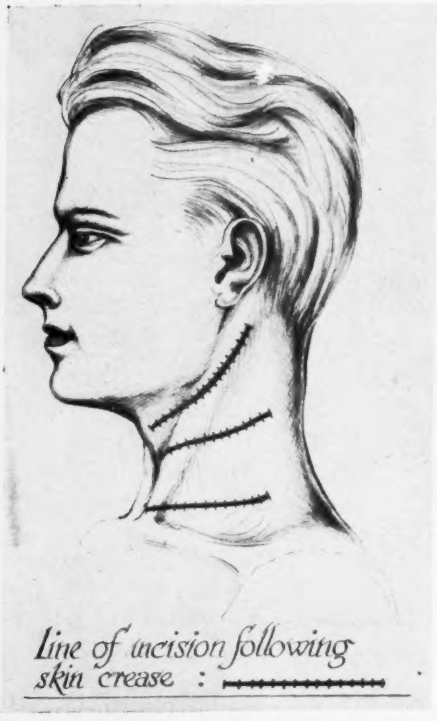

FIG. 9.—Illustration of incisions for exploration of carotid vessels. Often the incisions employed need not be as long as those here illustrated.

For more distal lesions in the subclavian vessels, an incision is made over the inferior border of the inner or midportion of the clavicle. In order to expose the subclavian vessels adequately it is necessary to resect a segment of the clavicle. This is done subperiosteally and the resected part is discarded. At the completion of the operation the periosteum is carefully sutured. Such patients are kept flat in bed for two weeks with their shoulders held well back. During the third week they are allowed up but are encouraged to spend a considerable portion of time lying on their backs. Very rapidly a firmness appears in the region where the clavicle is missing. Although at the end of three weeks roentgenograms reveal no definite evidence of bone regeneration, on clinical examination one can hardly tell that a clavicular resection has been done. Such patients have normal configuration of shoulders, normal motion, and are entirely comfortable (Fig. 11). Often after three months there is still no evidence roentgenographically of bone regeneration. Most of my own patients have not been observed longer. It is evident, however, that after an interval of six or eight months complete regeneration takes place in the majority of patients. In order to hasten bony regeneration, I am at present investigating the use of bone chips from the resected segment of the clavicle packed into the periosteal bed. The results of this study will be reported subsequently.

Mayfield[2] has observed a patient in whom, following periosteal excision of a segment of clavicle, excessive bone regeneration had occurred at the site where the periosteum was divided tranversely and sutured. No pressure symptoms were present in this individual, but, by analogy with cases of

large callus following fractures of the clavicle, it is possible that such bone regeneration might conceivably cause pressure upon the brachial plexus. Therefore, when it is necessary to transect the periosteum in order to facilitate exposure, it is advisable to do this in such a manner that the incision does not overlie the plexus.

In a single instance in which the resected clavicle was reinserted and fixed in place with wire sutures, the patient had a great deal of pain, union did not occur promptly, and the replaced portion of the clavicle was subsequently removed with relief of symptoms. We have seen a number of patients who were operated upon elsewhere with clavicular resection and replacement of the fragment or with division and resuture who have had

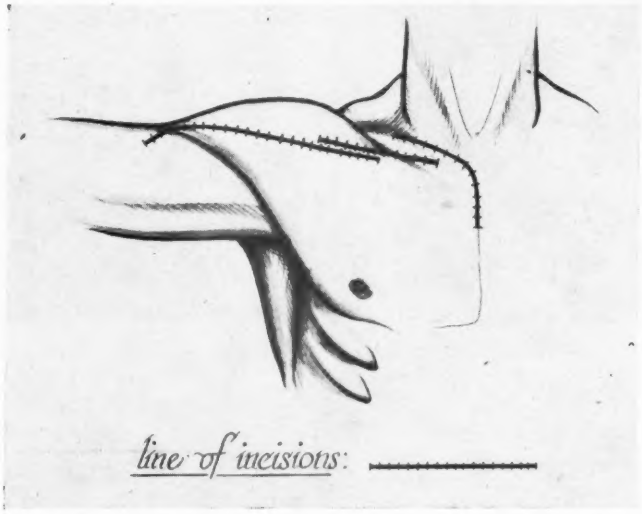

FIG. 10.—Illustration of incisions for exposure of innominate, subclavian, and axillary vessels.

difficulties of one sort or another. One had an osteomyelitis, another a painful malunion, and a third subluxation of the sternoclavicular joint. It is my conviction that where resection of a portion of the clavicle is essential, it is best discarded, and a careful reapproximation of the periosteum carried out, or that it be replaced with bone chips packed in the periosteal bed, and I am in complete agreement with Holman[1] that excision is preferable to division.

For lesions involving the axillary vessels, an incision is made over and parallel to the upper fibers of the pectoralis major, beginning in the region of the mid portion of the clavicle. In general, if the first half of the axillary vessels is all that needs be exposed, nothing more is necessary than to separate the upper fibers of the pectoralis major through such an incision and either to retract or transect through its insertion the pectoralis minor.

If the distal portion of the axillary vessels has to be explored, the incision continues out over the insertion of the pectoralis major and this muscle is divided through its tendonous insertion (Fig. 10). The incision described for the first portion of the brachial vessels is often adequate for the region of the distal end of the axillary vessels.

This incision begins over the insertion of the pectoralis major, curves down the inner aspect of the arm distal to the axilla, down to the region of the neurovascular bundle, and thence down a short distance over the course of these vessels (Fig. 12). When the skin flaps are reflected, the distal portion of the axillary vessels and the first portion of the brachial vessels are readily accessible. Incision through the axilla is thus avoided.

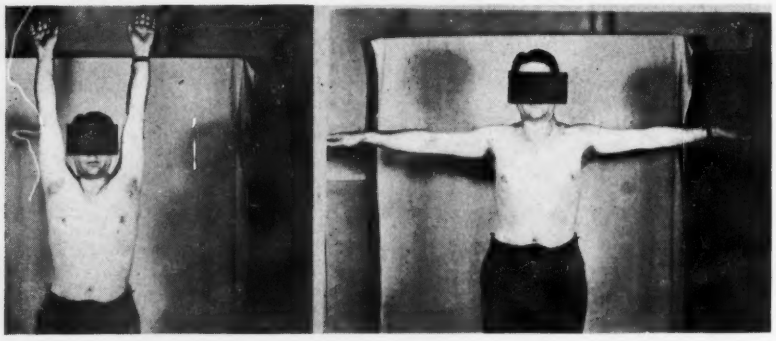

FIG. 11.—Photograph of patient after excision of fistula between internal mammary artery and innominate vein showing normal range of motion a month after resection of inner third of clavicle.

The disastrous results of incisions through the axilla—the keloids, heavy scars and disabling contractures—are familiar to all.

Such incisions for exposure of the subclavian, axillary, and first portion of the brachial vessels have been used in over 50 instances. The results have been gratifying. Adequate exposure has been obtained and proper surgical treatment of the aneurysm has been carried out without undue difficulty. Where concommitant nerve lesions have existed adequate exposure of these structures has been possible. No contractures have resulted. Where the tendonous insertion of the pectoralis minor or major has been divided, repair has resulted in good muscular function.

EXPOSURE OF OTHER PERIPHERAL ARTERIES

In general, exposure of other arteries in the upper and lower extremity can be carried out without difficulty by using properly placed longitudinal incisions. Such incisions cross no skin creases and do not result in any difficulty. For lesions of the common femoral artery and occasionally for the proximal portion of the femoral or profunda femoral artery, an oblique incision just below Poupart's ligament is preferable. If a lesion is found

to be too high to permit adequate exposure without proximal extension of a longitudinal incision, it is preferable to curve the incision up along the inguinal fold rather than to cross the crease.

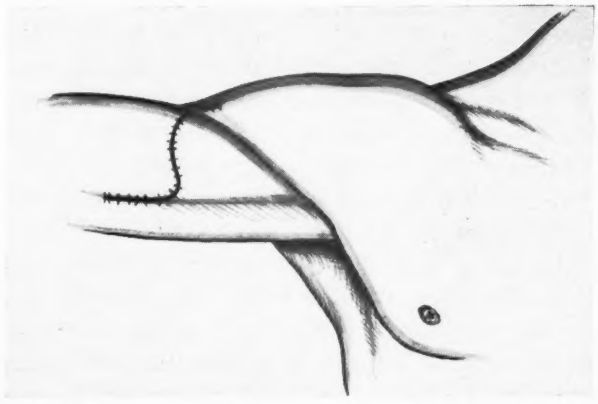

FIG. 12.—Illustration of incision for exploration of distal portion of axillary and first portion of brachial vessels.

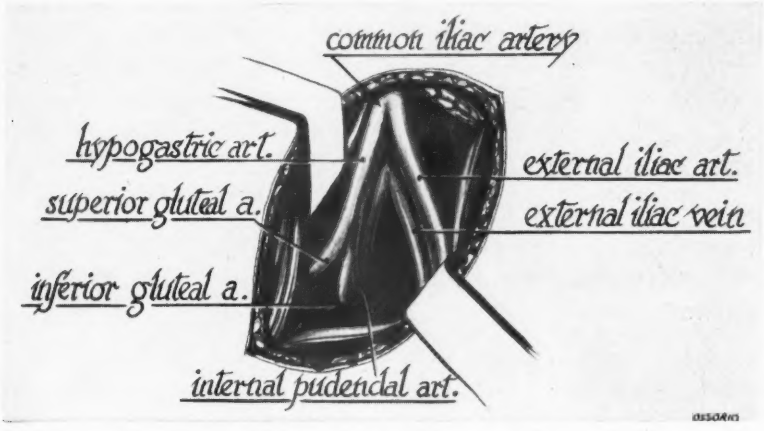

FIG. 13.—Operative exposure of left iliac and hypogastric vessels. The incision is a muscle-splitting extraperitoneal one. The ureter is retracted with the peritoneum.

The iliac vessels are best approached through oblique muscle splitting extraperitoneal incisions. For lesions of the distal external iliac vessels, an oblique incision just above Poupart's ligament is desirable. The fascia of the external oblique is divided, opening the external ring. The internal oblique is divided in the direction of its fibers as is the transversalis fascia. The iliac vessels are readily exposed above the inguinal ligament and the femoral vessels, if necessary, below the ligament. If the situation demands,

the inguinal ligament can be transected and resutured at the close of the procedure. Closure of the wound is carried out much as in a hernia repair. Lesions higher in the iliac vessels or in the hypogastric vessels or their branches are easily exposed through a left lower quadrant muscle-splitting extraperitoneal incision (Fig. 13). The external oblique, the internal oblique, and the transversalis are split in the direction of their fibers. The peritoneum is stripped back from the pelvic wall and retracted mesially. The ureter is retracted with the peritoneum. Good visualization of the common iliac, the external iliac, and the hypogastric vessels and their branches can be obtained.

Discussion.—In their legitimate desire to obtain easy and adequate exposure of vessels, it has been the custom of many surgeons to use incisions directly overlying the course of the involved vessels without regard to the crossing of natural creases and skin folds. When such incisions cross the popliteal fossa, the anticubital space, or the axilla, and when they transect the normal skin creases of the neck and groin, they are frequently followed by cosmetically unpleasing scars and not uncommonly by disabling contractures. In the author's experience, it is rarely, if ever, necessary to use incisions other than those which are sound from a plastic standpoint. A number of specific problems have been discussed, and methods which have proved satisfactory described. By use of such properly placed incisions, adequate exposure can be obtained without risk of keloids and contractures. The question may be asked whether ischemia of the distal flap may sometimes follow transverse incisions across the popliteal fossa and the anticubital space. The author feels that if the circulation is adequate for surgery of the aneurysm, the distal flap will have adequate blood supply.

SUMMARY

The problem of skin incisions in surgery of aneurysms is discussed with particular reference to the approach of the vessels in the anticubital space and popliteal fossa.

The author wishes to express his appreciation to Cpl. A. Ossario who made the illustrations.

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CROSS NERVE ANASTOMOSIS IN MAN

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Nerve anastomosis operations are of common practice especially during war and post-war periods. The technic has attained a standard leading to very satisfactory results. By cross nerve anastomosis is meant anastomosing the proximal segment of a nerve, or part of a nerve, into the distal segment of another, thus, providing the latter with functional activity from the former.

Such a method is well-known to have been applied in the treatment of cases of facial paralysis of traumatic origin where the distal segment of the facial was implanted into the proximal segment of the spinal accessory, but later into the hypoglossal nerve. The operation was applied in a fair number of cases by different surgeons, and over a period of many years, with varying opinions as to the final degrees of functional success. The results did not satisfy its originator, Sir Charles Ballance, who, after a long series of experiments in America with Dr. Arthur Duel, decided to give up his operation, recommending instead the use of degenerated nerve graft, and reporting results which were far superior. The causes of failure in facial cross nerve anastomosis will be discussed later.

Cross anastomosis of nerves is not a new procedure. Animal experiments on reciprocal cross nerve anastomosis were done more than a hundred years ago. The first experiments were those by Flourens, in 1827, who operating upon cock wings, cut the flexor and extensor nerves, implanted one segment into that of the other, and *vice versa,* with good functional recovery. Kilvington and Kennedy performed analogous experiments upon the dog, crossing flexor and extensor nerves, and also obtained good functional recovery.

The case reported herewith is believed to be the first instance where cross nerve anastomosis of peripheral nerves in limbs was applied in man.

Case Report.—S. H. A., male, age 35, was admitted to the University Hospital, Alexandria, August 3, 1943. The patient was a musician, playing the clarinet, an instrument requiring fine finger movements. He complained of marked disability of his right hand, which incapacitated him to such a degree that he had to find another more sedentary occupation.

Eight months previously, while working in a cabaret, a quarrel amongst the attending soldiers took place. He received an injury to his right forearm, by a piece of broken bottle. He bled considerably, and was taken to the hospital, where an operation was performed. The wound became septic, but after a long interval it became completely healed, leaving a disabled hand. Since then the condition progressed, and became worse. He developed a trophic ulcer on the thumb, and occasionally burned his fingers while applying an hot water bath, which had been recommended.

Examination revealed marked deformity of the right hand, which tended to be a claw-hand, with a small indolent ulcer on the pulp of the thumb. A wide, adherent scar was present on the volar surface of forearm, or its middle. Testing the nerve function in the locality proved that there was a complete severance of the median nerve with total sensory loss, accompanied by wasting and paralysis of the short thenar muscles. The

ulnar nerve, however, showed partial function. Although the hypothenar and interosseous muscles were wasted and paralyzed, yet its sensory functions were partially present. The radial pulse was absent. The muscles showed R. D.; and the case was diagnosed as complete severance of the median and partial severance of ulnar nerves. After such a long history operation was advised but the patient was given a guarded prognosis.

Operation.—A long incision at the medial side of forearm was made to expose the ulnar nerve segments first. The muscles under the scar were markedly adherent to skin and to each other, and at once it was apparent that direct exposure of the cut ends at the site of injury would be most difficult. Thus, the upper segment of the ulnar nerve was exposed high up and followed downwards to the cut end, which was found firm and bulbous. Turning to the lower segment near the wrist, it was followed upwards. As the dissection approached the site of injury, it was observed that the nerve had shifted lateralwards, continuing upwards and, strangely enough, it was found connected and firmly sealed to the upper segment of the median nerve. On searching for the distal segment of the median nerve, its upper cut-end was found to be free. This at once explained that the certain amount of function which existed in the ulnar nerve distribution in the hand was, in fact, due to this cross anastomosis of the upper median and the lower ulnar, *i.e.*, the patient had a median-ulnar nerve, which we may call here trunk A.

Considering that the union was firm, that there was a certain amount of function, and that further improvement in the regeneration of this accidental trunk was expected, and, considering the poor results in nerve suture in case of ulnar and median nerves in particular, it was decided, after consulting with Prof. Abbas Hilmy, to leave the existing cross anastomosis as such, and to perform a new one by joining the lower median to the upper ulnar. The anastomosis was performed and a fairly good bed for it was prepared deep to the flexor digitorum sublimis, and this trunk may be termed trunk B.

On account of the marked fibrosis of the cut-ends, a good length of each had to be excised and, to obviate tension, the wrist joint had to be flexed for some weeks in plaster. The postoperative progress was satisfactory; the ulcer on the thumb rapidly healed; and the patient was given electrotherapy.

He was discharged, and disappeared for a long time, until he was recently seen, almost two years after operation, when no further improvement could be expected.

He was satisfied by the progress he attained. Of course, no one expected he would be a musician again, but he found his hand most useful compared to the previous complete disability. On examination, it was found that his sensory functions had been fairly regained. Pinprick is well-felt with a slight flur. Sense of touch, tactile localization, and the discrimination test of single and double stimuli were all present, but slightly impaired. The short thenar muscles supplied by the new ulnamedian trunk B, formed by the secondary suture, showed fair recovery, and, although the size of thenar eminence continued to show some wasting, yet they worked the thumb very satisfactorily. Those supplied by the old trunk A, formed by the primary suture, eight months previous to the former, did not show the amount of recovery which was expected at the time of the operation, in fact, the motor function in its distribution is now poor.

Discussion.—This case is reported because of the unusual line followed during the operation. It also brings some points of interest and possible practical importance for consideration. The accidental cross anastomosis must have been done by the young doctor on duty, operating when the patient was received in a rush on the night of the accident. He sutured the ends of two separate nerves together with the idea that they were segments of the same nerve, but he eventually built up the new median-ulnar trunk A.

The dangers of, and failures following, primary nerve anastomosis in potentially septic cases have been repeatedly stressed, but it seems that they are

not yet fully appreciated in civil practice. The present case, herewith reported, is an excellent example to demonstrate the poor result of the primary suture applied for trunk A, followed by sepsis, and that of the second suture of trunk B performed eight months later. The latter is definitely superior in its ultimate results. During the operation we thought that regeneration and improvement in trunk A was still in progress, but later examination showed that we were probably wrong, and that its functional recovery had already reached its maximum. The palmar muscles concerned, (hypothenate and interosei) did not show any further marked improvement, whereas, the short muscles of the thumb, whose nerve supply was repaired eight months later, refunctioned satisfactorily. The improvement noticed by the patient of hand function was, really and mainly, due to the refunctioning of the thumb.

It has been already mentioned that cross anastomosis was not a new procedure, and that animal experiments had been undertaken some time ago. Recently, a very interesting investigation was undertaken in the same direction by Aird and Naffziger. They experimented on anastomosing nerves of small caliber into nerves of larger caliber, and described the phenomenon of luxuriant regeneration. In a series of experiments upon dogs, they cut the peroneal and tibial nerves and anastomosed the proximal peroneal into the distal segments of both peroneal and tibial, once immediately, another time after an interval. Simple cutting and resuturing of the same nerve was also done. In every instance they noticed 60 to 90 per cent motor recovery. On taking specimens from the nerves for a comparative fiber count, they demonstrated an increase in the count of 90, 50 and 35 per cent in the three types of experiments, respectively. They concluded that a definite increase in nerve fiber is apparently necessary for reinnervation and regeneration as in the third experiment, and that the increase is still more marked if a small nerve is implanted into a larger one, as in the first two experiments—a phenomenon they called luxuriant regeneration. Consequently, simple section and immediate anastomosis has been recommended for treating partially paralyzed nerves, and that completely paralyzed nerves, as in cases of anterior poliomyelitis, can be supplied with small sections of healthy nerves.

It was stated that the story was not so simple; and in the proper selection of cases there were limiting factors to be considered. If an intact nerve is selected for the anastomosis, the procedure must result in permanent weakening of the muscles previously and normally supplied by that nerve. Hence, only nerves or branches of nerves, the loss or partial loss of which will not cause appreciable disability should be selected. Without proper care in this respect the procedure may conceivably result in as much paralysis as that it is proposed to cure, or worse. Indeed, the use of intact nerve for this procedure does not yet appear to be justified. Because the estimation of functional recovery is so difficult with animals and conclusions based on experimental work frequently require modifications when applied to human conditions, any recommendation in this regard (the use of intact nerves) must be deferred until further data are available, on the degree of functional recovery following this procedure in man.

By recording this case, it is hoped that it would be of some help in the further elucidation of this highly important problem.

The experiments of Kilvington and Kennedy which, in a way, resemble those performed by Aird and Naffziger, are here repeated on the human, with good functional recovery. Still better results can be expected when muscles not so small and of so delicate action as those of the thumb are treated. The very important point to be solved is the choice of nerves or branches of nerves which can be sacrificed without marked disability.

The sacrifice of any nerve must certainly give rise to weakening, however little it may be. If by this sacrifice we aim at regaining function in another paralyzed nerve whose loss is already giving much more marked disability, one can expect, with good reason, that the final functional recovery of the part, as a whole, would be much improved.

The application of such a line of treatment would necessitate, in the first place, a detailed study of functional evaluation of different nerves in every locality, so as to standardize their relative importance when the question of substituting nerves of higher functional value by others of lower functional value is considered.

It has been already mentioned that cross nerve anastomosis in man was first applied by Ballance in the surgical treatment of posttraumatic facial paralysis, and this was in 1895. We are now prepared to discuss why this line of treatment, after being applied for more than 30 years, had proved a failure, that Ballance himself had to give it up and recommend, instead, treating such cases by filling the gap by a degenerated nerve graft.

Claud Coleman, in discussing the relative values of nerve cross anastomosis and nerve graft in cases of facial paralysis, states that both are satisfactory in correcting the appearance of the face during rest. Actually, the muscles of the mouth regain their tone in four to five months, and those of the eye in six months, the maximal regeneration taking place in two years. He does not believe that nerve grafting is superior to nerve anastomosis. He actually states that nerve anastomosis is the only adequate operation for intracranial lesions, *e.g.,* after excision of a cerebellopontine tumor, and recommended the facio-hypoglossal operation. The development of associated movements in face and tongue, which were first thought to be the great drawback of the operation, are easily overcome; tongue atrophy is also of no important significance, as it causes no appreciable interference with speech and deglutition.

Although associated movements, with time and trial, become dissociated, yet the nerve function remains far from normal. The two sides of the face do not work in harmony and on any emotional movement the deformity at once becomes disappointingly prominent.

Even with volitional movements, due to the distortion of regenerating fibrils in nerve suture and graft operations or their indifferent regeneration in anastomosis operation, the nerve works as a functional unit and the face on the affected side works *en masse.*

Older authors state that functional individuality gradually returns and even emotional expression slowly develops, yet they dispute the value of reëducation

of the affected side and advise instead the habit-formation of suppressing the emotional expressive movements on the normal side.

Coleman, although appearing as if he defends the operation of anastomosis, yet by his last statements he is actually approving the disappointment met with by others. In fact, nerve graft operation is definitely more both anatomic and physiologic.

This apparently sad view of nerve anastomosis operation in man is here presented to state that the face and limbs should not be compared in many respects, and operative results should not be the same in both. Although the face and hand can be compared to each other from the point of view that each comprises a number of small muscles concerned with fine movements yet they differ in a very essential fact, *i.e.,* bilateral symmetrical emotional expressions do not exist in the case of hand. Volitional movements in the face return *en masse* and, as mentioned before, only undergo individual dissociation after a fairly long time of reëducation. In the case of the hand, functional individuality developed fairly early and the patient's thumb worked almost exactly as a normal thumb.

If this is the result of operation in such a specialized part as the hand, still better results can be reasonably expected when the method is applied to larger muscles of less specialized action, as in the arm, foot, legs, and thighs.

Thus, where nerve anastomosia did not fully succeed in facial paralysis, there is good reason to hope that it can succeed in paralysis of other peripheral nerves in such conditions as anterior poliomyelitis, possibly with results in the vicinity of perfection. More and more work in this field is definitely needed, and there is every hope that it will be generously rewarded.

SUMMARY

1. A case is reported where, after a trauma, an accidental cross nerve anastomosis, median to ulnar, was performed, and at a subsequent operation another one was done, ulnar to median.

2. Fairly good results can be expected by such a procedure when applied in limbs, not to be compared with the disappointment met with in treating facial paralysis by faciohypoglossal anastomosis.

3. According to the clinical result obtained in the case reported, previous animal experiments and the phenomenon of luxuriant regeneration referred to, it is hoped that good function-recovering would be obtained when some small normal nerves of low functional value are sacrificed to provide activity for paralyzed larger nerves of greater functional value.

I wish to acknowledge, with deep thanks, the criticism and help of Prof. Abbas Hilmy in preparing this paper; and also thank my colleague Dr. M. Naïn for his help.

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BRIEF COMMUNICATION

FOREIGN BODY IN THE COLON

HOWARD R. DUDGEON, JR., M.D.
WACO, TEXAS

I wish to report a rather unusual case that was seen by me at the Providence Hospital of Waco, Texas. It is a fairly common occurrence for foreign objects to be introduced into the rectum or urethra for sexual purposes, but these are usually of small size. In the present instance the object was very large and was forced into the patient against his wishes.

FIG. 1.—Roentgenogram showing the bottle as it appeared in the descending colon. The actual size of the bottle is marked on the film in inches. On removal, it was found to be an ordinary olive bottle, 4 x 2 inches in size.

Case Report.—F. G., white, male, age 29, was carried into the hospital at 2 P. M., complaining of a foreign body in rectum. He states that he was taken out into the country by four men and that he was held and some object was forced into his rectum. It was very painful at the time and is causing him some pain now. He says that he is able to feel a mass in the left side of his abdomen, which is the object introduced. This was done last night.

About six weeks ago this same man was taken out in the country and an attempt was made to castrate him. This was done by some unknown men; at least the patient will not identify them to the police. At this time, no harm was done to the patient's testicles and the wound in the scrotum was repaired. The patient later shot a man, killing him, and he is now under indictment for murder.

Physical Examination.—The patient does not seem to be seriously injured or in pain. Head, neck and chest are negative. In the lower left quadrant of the abdomen, at the level of the crest of the ilium, there is a palpable mass the size of a hen's egg. The mass is definitely intra-abdominal. There is no tenderness, rigidity or distention of the abdomen. When pressure is made on the mass the patient states that he has a desire to defecate. Rectal inspection shows no abrasions of the anus or laceration of the sphincter. Digital examination is negative.

The patient was taken to the operating room and a proctoscopic examination made. The proctoscope was introduced well past the rectosigmoid junction and nothing was found. However, as the patient was very certain that he had something in his rectum and as there was an unexplained mass in his left side, a roentgenogram of the abdomen was made.

We were greatly surprised when the film showed a well-defined bottle, about 4–5 inches long, in the distal part of the descending colon. (The bottle was radiopaque due to the lead used in the manufacture of the glass).

Operation.—Under a spinal anesthesia, an attempt was made to remove the bottle by inserting forceps through a sigmoidoscope. Even with this instrument we were unable to reach or even see the bottle. Finally, we were forced to open the abdomen and perform a colotomy for removal of the bottle. The bottle was found to be four inches long and two inches across the mouth. It was located in the distal part of the descending colon. The colon was closed and the abdominal incision drained.

The patient made an uneventful recovery and was discharged from the hospital on the eighth postoperative day. There was no fistula formation, and he is completely recovered, four months after the operation.

Discussion.—The best way to have removed the bottle would have been through the rectum, but we were unable to do this. Opening the colon can be a dangerous thing to do, but luckily no complications developed. This patient did not have any fecal drainage from the wound and no wound infection. He was operated upon before the sulfa drugs were in common use; so he received no sulfadiazine or any of the others.

SUMMARY

The case history has been presented of a man with a foreign body in the colon which was introduced against his will, the treatment and the end-result.

ANNOUNCEMENT

THE PASSANO FOUNDATION AWARD

Selection of Dr. Ernest W. Goodpasture, Professor of Pathology and Dean of the School of Medicine of Vanderbilt University, Nashville, Tennessee, as the 1946 recipient of the Passano Foundation Award is announced by the Board of Directors of the Foundation. Presentation of the $5,000 cash award was made at an appropriate ceremony in historic Osler Hall of the Medical and Chirurgical Faculty of Maryland, in Baltimore, on the night of May 15th.

The Foundation, which was established in 1944 by the Williams and Wilkins Company, Medical Publishers, of Baltimore, proposes to aid in any way possible the advancement of medical research, especially research that bears promise of clinical application. For the encouragement of such research the Foundation has established the award as one of its activities.

Dr. Emil Novak, Associate in Gynecology in the Johns Hopkins University Medical School; Dr. Nicholson J. Eastman, Professor of Obstetrics in the Johns Hopkins University Medical School; Dr. George W. Corner, Director of the Embryologic Laboratory of the Carnegie Institution of Washington, represent the medical profession on the Board of Directors of The Foundation.

Following the presentation of the award by Mr. Edward B. Passano, Chairman of the Board of The Williams & Wilkins Company, Dr. Goodpasture delivered an address entitled, "Research and Medical Practice."

Dr. Goodpasture receives the award for his original development of the method for propagation of viruses in pure culture by inoculation of chick embryos and for his outstanding contributions to advancement of knowledge of the cell-parasite relationship in bacterial and virus infection.

Prior to Dr. Goodpasture's development of the chick embryo method of propagation of viruses in pure culture, medical research was halted in attempts to study diseases caused by viruses because of the fact that viruses will not multiply in culture media as do bacteria. Therefore, virus cultures could not be made available for research into the mechanism of their reactions.

As a result of Dr. Goodpasture's original discovery, some ten years ago, our knowledge of virus diseases has been immeasurably advanced. New viruses have been identified, the mechanism of virus reactions in the host have been studied and means of protection against many virus diseases have been made possible. Vaccines against several diseases of both man and animal against which little if any protection existed before have now been developed. Defenses against such diseases as fowlpox, smallpox, yellow fever, influenza and typhus fever have been considerably advanced by chick embryo study methods.